

Table A-2. Data for wells sampled for geochemical study in FY 2005.

Field Sample Number	Area	Location	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	Method Code	MDA	Validation Completed	Filtered Metal Sample	L&V Report Number
RISX5301LF	OFFSITE	CCC WELL 3	Aluminum	22.1		U		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Antimony	0.61		U		UG/L	06/30/2005	SW6020		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Arsenic	2.1				UG/L	06/30/2005	SW6020		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Barium	19.1		B		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Beryllium	0.13		U		UG/L	06/30/2005	SW6020		F	T	
RISX5301AN	OFFSITE	CCC WELL 3	Bromide	0.25		U		MG/L	06/30/2005	E300		F	F	
RISX5301LF	OFFSITE	CCC WELL 3	Cadmium	0.067		U		UG/L	06/30/2005	SW6020		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Calcium	33900				UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Chloride	13.1				MG/L	06/30/2005	E300		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Chromium	3.7		U		UG/L	06/30/2005	SW6020		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Cobalt	2.8		U		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Copper	1.1		U		UG/L	06/30/2005	SW6010B		F	T	
RISX5301AN	OFFSITE	CCC WELL 3	Fluoride	0.43				MG/L	06/30/2005	E300		F	F	
RISX5301LF	OFFSITE	CCC WELL 3	Iron	33.4		B		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Lead	1.1		U		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Lithium	18.2		B		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Magnesium	14400				UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Manganese	5.8				UG/L	06/30/2005	SW6020		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Mercury	0.1		U		UG/L	06/30/2005	SW7470A		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Molybdenum	3.7		U		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Nickel	3.2		U		UG/L	06/30/2005	SW6010B		F	T	
RISX5301N2	OFFSITE	CCC WELL 3	Nitrate/Nitrite as N	1				MG/L	06/30/2005	E353.1		F	F	
RISX5301LF	OFFSITE	CCC WELL 3	Potassium	2840		B		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Selenium	2		U		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Silicon	16000		N		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Silver	1.5		U		UG/L	06/30/2005	SW6020		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Sodium	15300				UG/L	06/30/2005	SW6020		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Strontium	159				UG/L	06/30/2005	SW6010B		F	T	
RISX5301AN	OFFSITE	CCC WELL 3	Sulfate	16.1				MG/L	06/30/2005	E300		F	F	
RISX5301LF	OFFSITE	CCC WELL 3	Thallium	0.64		B		UG/L	06/30/2005	SW6020		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Tin	3.9		U		UG/L	06/30/2005	SW6010B		F	T	
RISX5301A1	OFFSITE	CCC WELL 3	Total Alkalinity	124				MG/L	06/30/2005	E310.1		F	F	
RISX5301LF	OFFSITE	CCC WELL 3	Uranium	1.9		B		UG/L	06/30/2005	SW6020		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Vanadium	5.9		B		UG/L	06/30/2005	SW6010B		F	T	
RISX5301LF	OFFSITE	CCC WELL 3	Zinc	23.4				UG/L	06/30/2005	SW6010B		F	T	
RISX5101LF	OFFSITE	CROSS ROADS	Aluminum	22.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX5102LF	OFFSITE	CROSS ROADS	Aluminum	23.7		B		UG/L	06/20/2005	SW6010B		F	T	
RISX5101LF	OFFSITE	CROSS ROADS	Antimony	0.61		U		UG/L	06/20/2005	SW6020		F	T	
RISX5101LF	OFFSITE	CROSS ROADS	Antimony	0.61		U		UG/L	06/20/2005	SW6020		F	T	
RISX5101LF	OFFSITE	CROSS ROADS	Arsenic	1.8		U		UG/L	06/20/2005	SW6020		F	T	
RISX5102LF	OFFSITE	CROSS ROADS	Arsenic	1.8		U		UG/L	06/20/2005	SW6020		F	T	
RISX5101LF	OFFSITE	CROSS ROADS	Barium	44		B		UG/L	06/20/2005	SW6010B		F	T	
RISX5102LF	OFFSITE	CROSS ROADS	Barium	43.9		B		UG/L	06/20/2005	SW6020		F	T	
RISX5101LF	OFFSITE	CROSS ROADS	Beryllium	0.13		U		UG/L	06/20/2005	SW6020		F	T	
RISX5102LF	OFFSITE	CROSS ROADS	Beryllium	0.13		U		UG/L	06/20/2005	SW6020		F	T	
RISX5101AN	OFFSITE	CROSS ROADS	Bromide	0.25		U		MG/L	06/20/2005	E300		F	F	
RISX5102AN	OFFSITE	CROSS ROADS	Bromide	0.25		U		MG/L	06/20/2005	E300		F	F	
RISX5101LF	OFFSITE	CROSS ROADS	Cadmium	0.067		U		UG/L	06/20/2005	SW6020		F	T	
RISX5102LF	OFFSITE	CROSS ROADS	Cadmium	0.067		U		UG/L	06/20/2005	SW6020		F	T	
RISX5101LF	OFFSITE	CROSS ROADS	Calcium	44300				UG/L	06/20/2005	SW6010B		F	T	
RISX5102LF	OFFSITE	CROSS ROADS	Calcium	44300				UG/L	06/20/2005	SW6010B		F	T	
RISX5101AN	OFFSITE	CROSS ROADS	Chloride	9				MG/L	06/20/2005	E300		F	F	
RISX5102AN	OFFSITE	CROSS ROADS	Chloride	8.9				MG/L	06/20/2005	E300		F	F	
RISX5101LF	OFFSITE	CROSS ROADS	Chromium	5.6				UG/L	06/20/2005	SW6020		F	T	
RISX5102LF	OFFSITE	CROSS ROADS	Chromium	6.2				UG/L	06/20/2005	SW6020		F	T	
RISX5101LF	OFFSITE	CROSS ROADS	Cobalt	2.8		U		UG/L	06/20/2005	SW6010B		F	T	
RISX5102LF	OFFSITE	CROSS ROADS	Cobalt	2.8		U		UG/L	06/20/2005	SW6010B		F	T	

Table A-2. (continued).

Field Sample Number	Area	Location	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	Method Code	MDA	Validation Completed	Filtered Metal Sample	L&V Report Number
RISX51011F	OFFSITE	CROSS ROADS	Copper	1.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Copper	1.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51011AN	OFFSITE	CROSS ROADS	Fluoride	0.14				MG/L	06/20/2005	E300		F	F	
RISX51021AN	OFFSITE	CROSS ROADS	Fluoride	0.16				MG/L	06/20/2005	E300		F	F	
RISX51011F	OFFSITE	CROSS ROADS	Iron	24.3		B		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Iron	16.3		B		UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Lead	1.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Lead	1.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Lithium	3		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Lithium	3		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Magnesium	14700				UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Magnesium	14600				UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Manganese	0.54		U		UG/L	06/20/2005	SW6020		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Manganese	0.54		U		UG/L	06/20/2005	SW6020		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Mercury	0.14		B		UG/L	06/20/2005	SW7470A		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Mercury	0.1		U		UG/L	06/20/2005	SW7470A		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Molybdenum	3.7		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Molybdenum	3.7		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Nickel	3.2		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Nickel	3.2		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51011N2	OFFSITE	CROSS ROADS	Nitrate/Nitrite as N	0.94				MG/L	06/20/2005	E353.1		F	F	
RISX51021N2	OFFSITE	CROSS ROADS	Nitrate/Nitrite as N	0.96				MG/L	06/20/2005	E353.1		F	F	
RISX51011F	OFFSITE	CROSS ROADS	Potassium	1690		B		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Potassium	2900		B		UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Selenium	2		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Selenium	2		B		UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Silicon	11400				UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Silicon	11400				UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Silver	1.5		U		UG/L	06/20/2005	SW6020		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Silver	1.5		U		UG/L	06/20/2005	SW6020		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Sodium	7740				UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Sodium	7700				UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Strontium	256				UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Strontium	255				UG/L	06/20/2005	SW6010B		F	T	
RISX51011AN	OFFSITE	CROSS ROADS	Sulfate	19.2				UG/L	06/20/2005	SW6010B		F	T	
RISX51021AN	OFFSITE	CROSS ROADS	Sulfate	19.6				MG/L	06/20/2005	E300		F	F	
RISX51011F	OFFSITE	CROSS ROADS	Thallium	0.79		B		UG/L	06/20/2005	SW6020		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Thallium	0.43		B		UG/L	06/20/2005	SW6020		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Tin	3.9		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Tin	3.9		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51011A1	OFFSITE	CROSS ROADS	Total Alkalinity	141				MG/L	06/20/2005	E310.1		F	F	
RISX51021A1	OFFSITE	CROSS ROADS	Total Alkalinity	142				MG/L	06/20/2005	E310.1		F	F	
RISX51011F	OFFSITE	CROSS ROADS	Uranium	2.1		B		UG/L	06/20/2005	SW6020		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Uranium	2		B		UG/L	06/20/2005	SW6020		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Vanadium	4.1		B		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Vanadium	4.3		B		UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	OFFSITE	CROSS ROADS	Zinc	57.7		E		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	OFFSITE	CROSS ROADS	Zinc	58.3		E		UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	WAG 10	FIELD BLANK	Aluminum	22.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51021F	WAG 10	FIELD BLANK	Antimony	0.61		U		UG/L	06/20/2005	SW6020		F	T	
RISX51011F	WAG 10	FIELD BLANK	Arsenic	1.8		U		UG/L	06/20/2005	SW6020		F	T	
RISX51021F	WAG 10	FIELD BLANK	Barium	0.85		U		UG/L	06/20/2005	SW6010B		F	T	
RISX51011F	WAG 10	FIELD BLANK	Beryllium	0.13		U		UG/L	06/20/2005	SW6020		F	T	
RISX51021F	WAG 10	FIELD BLANK	Bromide	0.25		U		MG/L	06/20/2005	E300		F	F	
RISX51011F	WAG 10	FIELD BLANK	Cadmium	0.067		U		UG/L	06/20/2005	SW6020		F	T	
RISX51021F	WAG 10	FIELD BLANK	Calcium	71.2		B		UG/L	06/20/2005	SW6010B		F	T	
RISX51011AN	WAG 10	FIELD BLANK	Chloride	0.2		U		MG/L	06/20/2005	E300		F	F	

Table A-2. (continued).

Field Sample Number	Area	Location	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	Method Code	MDA	Validation Completed	Filtered Metal Sample	L&V Report Number
RISX6201LF	WAG 10	FIELD BLANK	Chromium	4.7		B		UG/L	06/20/2005	SW6020		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Cobalt	2.8		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Copper	1.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201AN	WAG 10	FIELD BLANK	Fluoride	0.1		U		MG/L	06/20/2005	E300		F	F	
RISX6201LF	WAG 10	FIELD BLANK	Iron	7.4		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Lead	1.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Lithium	3		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Magnesium	45.7		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Manganese	0.54		U		UG/L	06/20/2005	SW6020		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Mercury	0.1		U		UG/L	06/20/2005	SW7470A		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Molybdenum	3.7		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Nickel	3.2		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201N2	WAG 10	FIELD BLANK	Nitrate/Nitrite as N	50		U		MG/L	06/20/2005	E353.1		F	F	
RISX6201LF	WAG 10	FIELD BLANK	Potassium	961		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Selenium	2		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Silicon	5.4		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Silver	1.5		U		UG/L	06/20/2005	SW6020		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Sodium	58.5		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Strontium	0.63		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201AN	WAG 10	FIELD BLANK	Sulfate	0.5		U		MG/L	06/20/2005	E300		F	F	
RISX6201LF	WAG 10	FIELD BLANK	Thallium	0.22		U		UG/L	06/20/2005	SW6020		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Tin	3.9		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201A1	WAG 10	FIELD BLANK	Total Alkalinity	ND		U		MG/L	06/20/2005	E310.1		F	F	
RISX6201LF	WAG 10	FIELD BLANK	Uranium	0.14		U		UG/L	06/20/2005	SW6020		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Vanadium	2.5		U		UG/L	06/20/2005	SW6010B		F	T	
RISX6201LF	WAG 10	FIELD BLANK	Zinc	11.6		BE		UG/L	06/20/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Aluminum	22.1		U		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Antimony	0.61		U		UG/L	06/28/2005	SW6020		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Arsenic	1.8		U		UG/L	06/28/2005	SW6020		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Barium	31.8		B		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Beryllium	0.13		U		UG/L	06/28/2005	SW6020		F	T	
RISX5201AN	OFFSITE	FINGER BUTTE	Bromide	0.25		U		MG/L	06/28/2005	E300		F	F	
RISX5201LF	OFFSITE	FINGER BUTTE	Cadmium	0.067		U		UG/L	06/28/2005	SW6020		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Calcium	40400				UG/L	06/28/2005	SW6010B		F	T	
RISX5201AN	OFFSITE	FINGER BUTTE	Chloride	9.7				MG/L	06/28/2005	E300		F	F	
RISX5201LF	OFFSITE	FINGER BUTTE	Chromium	3.8		B		UG/L	06/28/2005	SW6020		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Cobalt	2.8		U		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Copper	1.1		U		UG/L	06/28/2005	SW6010B		F	T	
RISX5201AN	OFFSITE	FINGER BUTTE	Fluoride	0.15				MG/L	06/28/2005	E300		F	F	
RISX5201LF	OFFSITE	FINGER BUTTE	Iron	19.6		B		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Lead	1.1		U		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Lithium	7.6		B		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Magnesium	14400				UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Manganese	0.54		U		UG/L	06/28/2005	SW6020		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Mercury	0.1		U		UG/L	06/28/2005	SW7470A		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Molybdenum	3.7		U		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Nickel	3.2		U		UG/L	06/28/2005	SW6010B		F	T	
RISX5201N2	OFFSITE	FINGER BUTTE	Nitrate/Nitrite as N	0.8				MG/L	06/28/2005	E353.1		F	F	
RISX5201LF	OFFSITE	FINGER BUTTE	Potassium	2850		B		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Selenium	2.1		B		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Silicon	12500		N		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Silver	1.5		U		UG/L	06/28/2005	SW6020		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Sodium	8970				UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Strontium	237				UG/L	06/28/2005	SW6010B		F	T	
RISX5201AN	OFFSITE	FINGER BUTTE	Sulfate	19.9				MG/L	06/28/2005	E300		F	F	
RISX5201LF	OFFSITE	FINGER BUTTE	Thallium	0.22		U		UG/L	06/28/2005	SW6020		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Tin	3.9		U		UG/L	06/28/2005	SW6010B		F	T	

Table A-2. (continued).

Field Sample Number	Area	Location	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	Method Code	MDA	Validation Completed	Filtered Metal Sample	L&V Report Number
RISX5201A1	OFFSITE	FINGER BUTTE	Total Alkalinity	124				MG/L	06/28/2005	E310.1		F	F	
RISX5201LF	OFFSITE	FINGER BUTTE	Uranium	2		B		UG/L	06/28/2005	SW6020		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Vanadium	6		B		UG/L	06/28/2005	SW6010B		F	T	
RISX5201LF	OFFSITE	FINGER BUTTE	Zinc	13.1				UG/L	06/28/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Aluminum	22.1		U		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Antimony	0.61		U		UG/L	07/05/2005	SW6020		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Arsenic	1.8		U		UG/L	07/05/2005	SW6020		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Barium	24.1		B		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Beryllium	0.13		U		UG/L	07/05/2005	SW6020		F	T	
RISX5401AN	OFFSITE	GRAZING-2	Bromide	0.25		U		MG/L	07/05/2005	E300		F	F	
RISX5401LF	OFFSITE	GRAZING-2	Cadmium	0.067		U		UG/L	07/05/2005	SW6020		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Calcium	33400				UG/L	07/05/2005	SW6010B		F	T	
RISX5401AN	OFFSITE	GRAZING-2	Chloride	12.4				MG/L	07/05/2005	E300		F	F	
RISX5401LF	OFFSITE	GRAZING-2	Chromium	3.7		U		UG/L	07/05/2005	SW6020		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Cobalt	2.8		U		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Copper	1.1		U		UG/L	07/05/2005	SW6010B		F	T	
RISX5401AN	OFFSITE	GRAZING-2	Fluoride	0.52				MG/L	07/05/2005	E300		F	F	
RISX5401LF	OFFSITE	GRAZING-2	Iron	14		B		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Lead	1.1		U		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Lithium	22.2		B		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Magnesium	14100				UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Manganese	0.54		U		UG/L	07/05/2005	SW6020		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Mercury	0.1		U		UG/L	07/05/2005	SW7470A		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Molybdenum	3.7		U		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Nickel	3.2		U		UG/L	07/05/2005	SW6010B		F	T	
RISX5401N2	OFFSITE	GRAZING-2	Nitrate/Nitrite as N	1.1				MG/L	07/05/2005	E353.1		F	F	
RISX5401LF	OFFSITE	GRAZING-2	Potassium	2540		B		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Selenium	2		U		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Silicon	16500		N		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Silver	1.5		U		UG/L	07/05/2005	SW6020		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Sodium	15700				UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Strontium	153				UG/L	07/05/2005	SW6010B		F	T	
RISX5401AN	OFFSITE	GRAZING-2	Sulfate	14.6				MG/L	07/05/2005	E300		F	F	
RISX5401LF	OFFSITE	GRAZING-2	Thallium	0.22		U		UG/L	07/05/2005	SW6020		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Tin	3.9		U		UG/L	07/05/2005	SW6010B		F	T	
RISX5401A1	OFFSITE	GRAZING-2	Total Alkalinity	122				MG/L	07/05/2005	E310.1		F	F	
RISX5401LF	OFFSITE	GRAZING-2	Uranium	1.9		B		UG/L	07/05/2005	SW6020		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Vanadium	7.1		B		UG/L	07/05/2005	SW6010B		F	T	
RISX5401LF	OFFSITE	GRAZING-2	Zinc	95.3				UG/L	07/05/2005	SW6010B		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Aluminum	26.3		B		UG/L	06/20/2005	SW6010B		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Antimony	0.61		U		UG/L	06/20/2005	SW6020		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Arsenic	1.8		U		UG/L	06/20/2005	SW6020		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Barium	17		B		UG/L	06/20/2005	SW6010B		F	T	
RISX5501AN	OFFSITE	HOUGHLAND	Beryllium	0.13				UG/L	06/20/2005	SW6020		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Bromide	0.25		U		UG/L	06/20/2005	SW6010B		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Cadmium	0.067		U		UG/L	06/20/2005	E300		F	F	
RISX5501LF	OFFSITE	HOUGHLAND	Calcium	33400				UG/L	06/20/2005	SW6020		F	T	
RISX5501AN	OFFSITE	HOUGHLAND	Chloride	14.7				MG/L	06/20/2005	SW6010B		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Chromium	8				UG/L	06/20/2005	E300		F	F	
RISX5501LF	OFFSITE	HOUGHLAND	Cobalt	2.8		U		UG/L	06/20/2005	SW6020		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Copper	1.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX5501AN	OFFSITE	HOUGHLAND	Fluoride	0.39				MG/L	06/20/2005	E300		F	F	
RISX5501LF	OFFSITE	HOUGHLAND	Iron	8.2		B		UG/L	06/20/2005	SW6010B		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Lead	1.1		U		UG/L	06/20/2005	SW6010B		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Lithium	3.5		B		UG/L	06/20/2005	SW6010B		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Magnesium	16400				UG/L	06/20/2005	SW6010B		F	T	
RISX5501LF	OFFSITE	HOUGHLAND	Manganese	0.54		U		UG/L	06/20/2005	SW6020		F	T	

Table A-2. (continued).

Field Sample Number	Area	Location	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	Method Code	MDA	Validation Completed	Filtered Metal Sample	L&V Report Number
RISX5601LF	OFFSITE	HOUGHLAND	Mercury	0.1		U		UG/L	06/20/2005	SW7470A		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Molybdenum	3.7		U		UG/L	06/20/2005	SW6010B		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Nickel	3.2		U		UG/L	06/20/2005	SW6010B		F	T	
RISX5601N2	OFFSITE	HOUGHLAND	Nitrate/Nitrite as N	0.97				MG/L	06/20/2005	E353.1		F	F	
RISX5601LF	OFFSITE	HOUGHLAND	Potassium	3690		B		UG/L	06/20/2005	SW6010B		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Selenium	2		U		UG/L	06/20/2005	SW6010B		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Silicon	16500				UG/L	06/20/2005	SW6010B		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Silver	1.5		U		UG/L	06/20/2005	SW6020		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Sodium	15900				UG/L	06/20/2005	SW6010B		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Strontium	190				UG/L	06/20/2005	SW6010B		F	T	
RISX5601AN	OFFSITE	HOUGHLAND	Sulfate	18.3				MG/L	06/20/2005	E300		F	F	
RISX5601LF	OFFSITE	HOUGHLAND	Thallium	0.25		B		UG/L	06/20/2005	SW6020		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Tin	3.9		U		UG/L	06/20/2005	SW6010B		F	T	
RISX5601A1	OFFSITE	HOUGHLAND	Total Alkalinity	128				MG/L	06/20/2005	E310.1		F	F	
RISX5601LF	OFFSITE	HOUGHLAND	Uranium	2		B		UG/L	06/20/2005	SW6020		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Vanadium	8.2		B		UG/L	06/20/2005	SW6010B		F	T	
RISX5601LF	OFFSITE	HOUGHLAND	Zinc	24.8		E		UG/L	06/20/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Aluminum	63		B		UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Antimony	0.61		U		UG/L	06/04/2005	SW6020		F	T	
RISX5601LF	TRA	MIDDLE-1823	Arsenic	1.8		U		UG/L	06/04/2005	SW6020		F	T	
RISX5601LF	TRA	MIDDLE-1823	Barium	74.6		B		UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Beryllium	0.13		U		UG/L	06/04/2005	SW6020		F	T	
RISX5601AN	TRA	MIDDLE-1823	Bromide	0.25		U		MG/L	06/07/2005	E300		F	F	
RISX5601LF	TRA	MIDDLE-1823	Cadmium	0.067		U		UG/L	06/04/2005	SW6020		F	T	
RISX5601LF	TRA	MIDDLE-1823	Calcium	56000				UG/L	06/04/2005	SW6010B		F	T	
RISX5601AN	TRA	MIDDLE-1823	Chloride	11.4				MG/L	06/07/2005	E300		F	F	
RISX5601LF	TRA	MIDDLE-1823	Chromium	10.5		U		UG/L	06/04/2005	SW6020		F	T	
RISX5601LF	TRA	MIDDLE-1823	Cobalt	2.8		U		UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Copper	1.1		U		UG/L	06/04/2005	SW6010B		F	T	
RISX5601AN	TRA	MIDDLE-1823	Fluoride	0.13				MG/L	06/07/2005	E300		F	F	
RISX5601LF	TRA	MIDDLE-1823	Iron	13.5		B		UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Lead	1.1		U		UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Lithium	3		U		UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Magnesium	18400				UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Manganese	9.3				UG/L	06/04/2005	SW6020		F	T	
RISX5601LF	TRA	MIDDLE-1823	Mercury	0.1		U		UG/L	06/04/2005	SW7470A		F	T	
RISX5601LF	TRA	MIDDLE-1823	Molybdenum	3.7		U		UG/L	06/04/2005	SW6010B		F	T	
RISX5601N2	TRA	MIDDLE-1823	Nickel	4.8		B		MG/L	06/07/2005	E353.1		F	F	
RISX5601LF	TRA	MIDDLE-1823	Nitrate/Nitrite as N	1.3				UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Potassium	1290		B		UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Selenium	2.4		B		UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Silicon	10300				UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Silver	1.5		U		UG/L	06/04/2005	SW6020		F	T	
RISX5601LF	TRA	MIDDLE-1823	Sodium	17500				UG/L	06/04/2005	SW6010B		F	T	
RISX5601AN	TRA	MIDDLE-1823	Strontium	292				UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Sulfate	33.3				MG/L	06/07/2005	E300		F	F	
RISX5601LF	TRA	MIDDLE-1823	Thallium	0.91		B		UG/L	06/04/2005	SW6020		F	T	
RISX5601LF	TRA	MIDDLE-1823	Tin	3.9		U		UG/L	06/04/2005	SW6010B		F	T	
RISX5601A1	TRA	MIDDLE-1823	Total Alkalinity	182				MG/L	06/07/2005	E310.1		F	F	
RISX5601LF	TRA	MIDDLE-1823	Uranium	2.7		B		UG/L	06/04/2005	SW6020		F	T	
RISX5601LF	TRA	MIDDLE-1823	Vanadium	3.7		B		UG/L	06/04/2005	SW6010B		F	T	
RISX5601LF	TRA	MIDDLE-1823	Zinc	5.7		B		UG/L	06/04/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Aluminum	68.5		B		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Antimony	0.61		U		UG/L	06/06/2005	SW6020		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Arsenic	1.8		U		UG/L	06/06/2005	SW6020		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Barium	84.6		B		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Beryllium	0.13		U		UG/L	06/06/2005	SW6020		F	T	

Table A-2. (continued).

Field Sample Number	Area	Location	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	Method Code	MDA	Validation Completed	Filtered Metal Sample	L&V Report Number
RISX5701AN	SOUTH INEEL	RIFLE RANGE	Bromide	0.25		U		MG/L	06/06/2005	E300		F	F	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Cadmium	0.067		U		UG/L	06/06/2005	SW6020		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Calcium	58100				UG/L	06/06/2005	SW6010B		F	T	
RISX5701AN	SOUTH INEEL	RIFLE RANGE	Chloride	26.6				MG/L	06/06/2005	E300		F	F	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Chromium	14.3				UG/L	06/06/2005	SW6020		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Cobalt	2.8		U		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Copper	1.1		U		UG/L	06/06/2005	SW6010B		F	T	
RISX5701AN	SOUTH INEEL	RIFLE RANGE	Fluoride	0.14				MG/L	06/06/2005	E300		F	F	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Iron	31.1		B		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Lead	1.1		U		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Lithium	3		U		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Magnesium	17400				UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Manganese	0.82		B		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Mercury	0.1		U		UG/L	06/06/2005	SW6020		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Molybdenum	3.7		U		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Nickel	3.2		U		UG/L	06/06/2005	SW6010B		F	T	
RISX5701N2	SOUTH INEEL	RIFLE RANGE	Nitrate/Nitrite as N	1.1				MG/L	06/06/2005	E353.1		F	F	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Potassium	1420		B		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Selenium	2.9		B		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Silicon	10800				UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Silver	1.5		U		UG/L	06/06/2005	SW6020		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Sodium	11100				UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Strontium	324				UG/L	06/06/2005	SW6010B		F	T	
RISX5701AN	SOUTH INEEL	RIFLE RANGE	Sulfate	29.6				MG/L	06/06/2005	E300		F	F	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Thallium	0.44		B		UG/L	06/06/2005	SW6020		F	T	
RISX5701A1	SOUTH INEEL	RIFLE RANGE	Tin	3.9		U		UG/L	06/06/2005	SW6010B		F	T	
RISX5701AN	SOUTH INEEL	RIFLE RANGE	Total Alkalinity	154				MG/L	06/06/2005	E310.1		F	F	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Uranium	2.1		B		UG/L	06/06/2005	SW6020		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Vanadium	3.7		B		UG/L	06/06/2005	SW6010B		F	T	
RISX5701LF	SOUTH INEEL	RIFLE RANGE	Zinc	80.2				UG/L	06/06/2005	SW6010B		F	T	
RISX5801AN	TRA	USGS-065	Bromide	0.057		B		MG/L	06/07/2005	E300		F	F	
RISX5801AN	TRA	USGS-065	Chloride	18.6				MG/L	06/07/2005	E300		F	F	
RISX5801AN	TRA	USGS-065	Fluoride	0.16				MG/L	06/07/2005	E300		F	F	
RISX5801N2	TRA	USGS-065	Nitrate/Nitrite as N	2				MG/L	06/07/2005	E353.1		F	F	
RISX5801AN	TRA	USGS-065	Sulfate	157				MG/L	06/07/2005	E300		F	F	

Appendix B

Geochemical Study

Appendix B

Geochemical Study

B-1. INTRODUCTION

This appendix presents the data collected for the geochemical study. The goals of the geochemical study were to resolve the source of the tritium in the aquifer at the RWMC, identify flow paths of contaminants from INTEC and RTC, determine the source of the anion anomaly south of the RWMC, and identify flow paths and evaluate contaminant influence south of the southern INL Site boundary (Figure B-1). Identification of groundwater flow paths is essential for development and calibration of the OU 10-08 (i.e., Sitewide) groundwater model. In addition, data from the geochemical study are used to evaluate the potential for commingled plumes, which might elevate the cumulative risk above levels calculated for each plume individually.

The geochemical study used four tracers that are currently in the SRPA as a result of INL Site operations: Cl-36, I-129, sulfur and oxygen isotope ratios in sulfate, and nitrogen and oxygen isotope ratios in nitrate. However, I-129 results are not available for this report, but they will be incorporated into the FY 2006 annual report. These four tracers were selected based on their ability to distinguish sources and to be tracked over great distances. Cl-36 and nitrogen and oxygen isotope ratios in nitrate are used to evaluate flow paths from INTEC. Cl-36 and sulfur and oxygen isotope ratios in sulfate will be used to track plumes from RTC. Sulfur and oxygen isotope ratios in sulfate, along with nitrogen and oxygen isotope ratios in nitrate, are used to evaluate the source of the anion anomaly south of the RWMC (Figure B-2). The much lower detection limits using the AMS method for Cl-36 enables plumes and groundwater flow paths to be tracked over greater distances south of the INL Site boundary.

Select plumes in the INTEC-RTC-CFA-RWMC area are shown on Figure B-2, along with groundwater contours, to illustrate the potential for commingling plumes and the possibility of upgradient influence on the RWMC. In general, the contaminant distributions in the SRPA agree with groundwater flow paths indicated by the water level contours. However, the upgradient influences from RTC and INTEC on the RWMC are uncertain because of the possibility of preferential flow paths. If there is an upgradient influence at the RWMC, then it is within the scope of OU 10-08 to account for the effects of commingling plumes in the OU 10-08 RI/FS.

B-2. Cl-36 RESULTS AND DISCUSSION

The goals of the Cl-36 sampling are to define groundwater flow paths from INTEC and RTC, to determine the potential for upgradient influences at the RWMC, to evaluate the potential for commingling plumes, and to evaluate the extent of contaminant migration south of the INL Site boundary. Existing data are insufficient to clearly identify whether groundwater contaminants beneath the RWMC are from the RWMC or from RTC and INTEC.

B-2.1 Cl-36 results

The Cl-36 results are reported in Table B-1. The locations of wells sampled for Cl-36 are shown on Figure B-3.

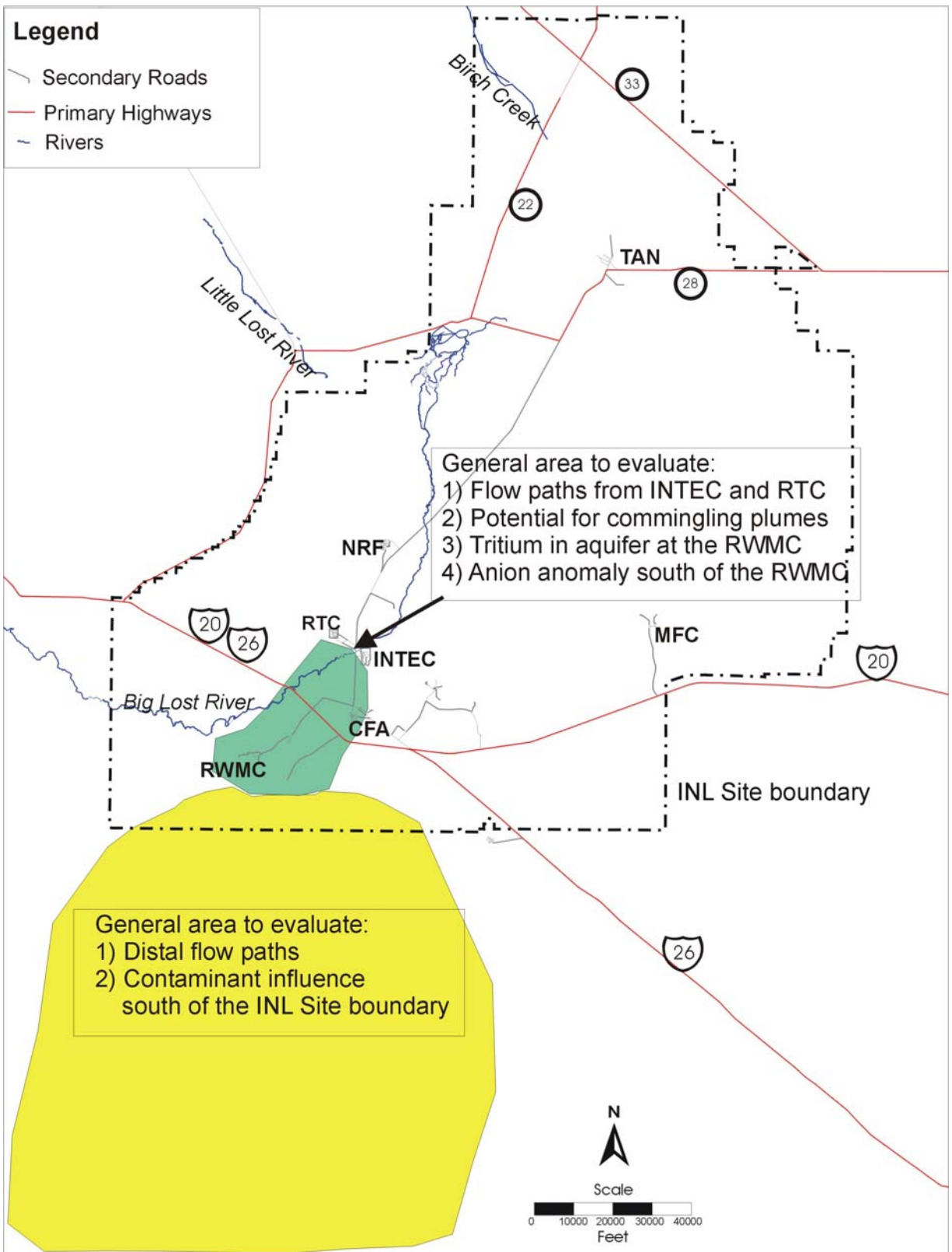


Figure B-1. Geochemical study areas.

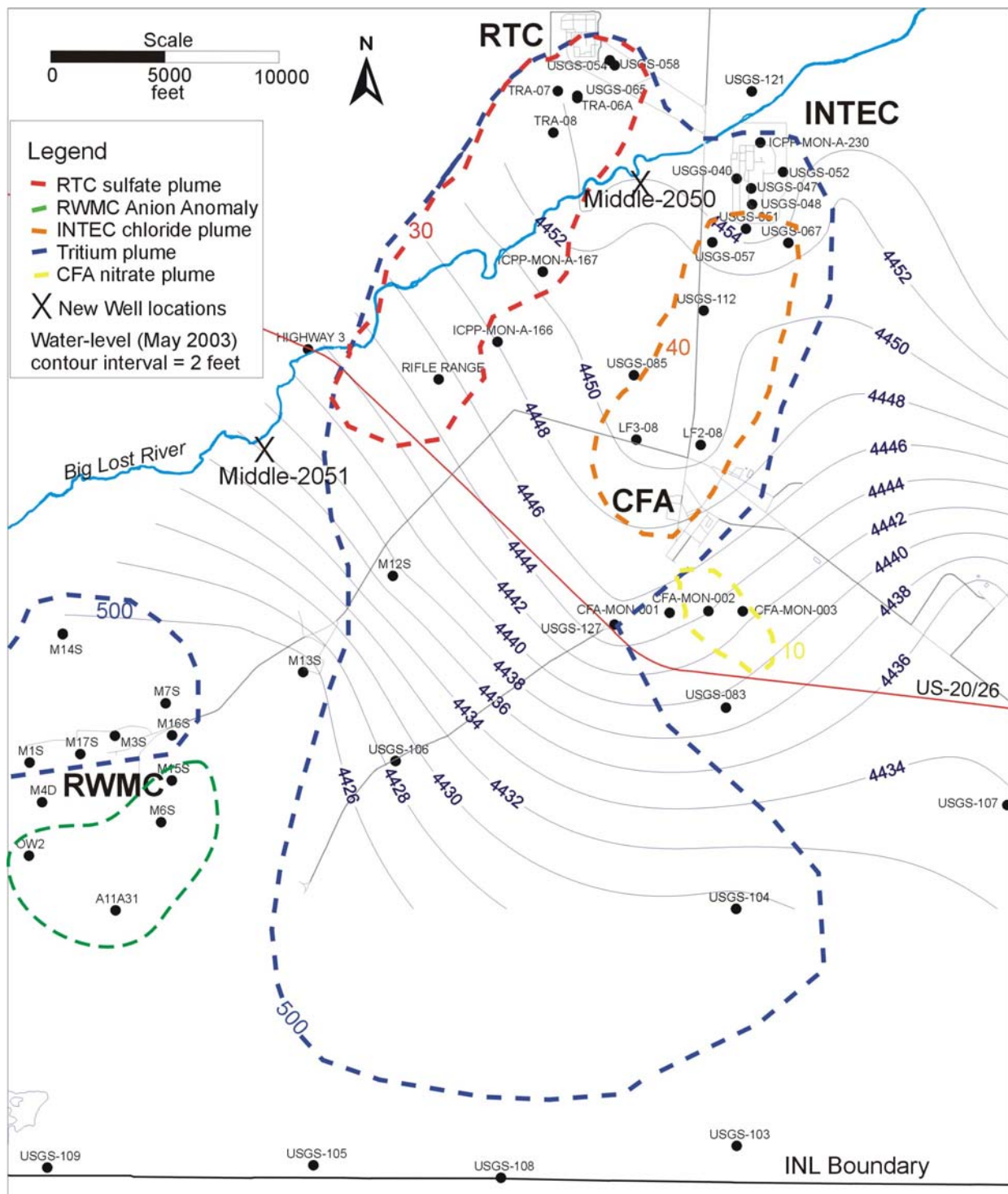


Figure B-2. Approximate boundaries of select plumes based on concentrations in 2003 for the RTC, INTEC, CFA, and RWMC areas.

Table B-1. Cl-36 results.

Location	Insitu $^{36}\text{Cl}/\text{Cl}$	+/-	Chloride (mg/L)	^{36}Cl (10^{10} Atoms)	+/-	^{36}Cl (pCi/L)	+/-
<u>Wells sampled in 2005</u>							
M1S	16	437	13.7	0.000374	0.0102	0.00000748	0.000204
M6S	834	296	23.4	0.0328	0.0118	0.000656	0.000236
M11S	1,297	456	18.3	0.04	0.0142	0.0008	0.000284
M12S	404,724	14,151	15.5	10.6	0.373	0.212	0.00746
M13S	253	1,138	5.17	0.00222	0.01	0.0000444	0.0002
M14S	402,162	19,655	14.5	9.84	0.484	0.1968	0.00968
A11A31	15,067	706	28.2	0.713	0.0338	0.01426	0.000676
RWMC production	262,608	8,318	18.3	8.09	0.259	0.1618	0.00518
Crossroads well	1,372	185	9.0	0.0194	0.00282	0.000388	0.0000564
Fingers Butte	340	45	9.7	0.00512	0.000742	0.0001024	0.0000148
Graz Serv CCC3	284	50	13.1	0.00556	0.00111	0.0001112	0.0000222
Grazing 2	286	52	12.4	0.00539	0.0011	0.0001078	0.000022
Houghland	1,942	171	14.7	0.0425	0.00426	0.00085	0.0000852
Middle-1823	69,948	1,562	11.4	1.35	0.126	0.027	0.00252
USGS-009	3,980	344	16.9	0.107	0.00988	0.00214	0.000198
USGS-105	84,826	1,697	13.7	1.97	0.147	0.0394	0.00294
USGS-108	13,896	555	14.9	0.352	0.0145	0.00704	0.00029
USGS-109	37,264	1,517	13.7	0.827	0.0353	0.01654	0.000706
USGS-106	211,078	7,208	15.7	5.57	0.192	0.1114	0.00384
USGS-125	27,862	1,628	11.9	0.532	0.0329	0.01064	0.000658
USGS-124	35,127	1,046	14.8	0.824	0.0263	0.01648	0.000526
USGS-011	6,465	274	10.4	0.109	0.00484	0.00218	0.0000968
USGS-014	1,613	161	21.9	0.0544	0.006	0.001088	0.00012
<u>Wells sampled in 1992 (Beasley 1995)^a</u>							
RWMC production	227,000	19,000	15	5.8	0.5	0.116	0.01
Crossroads well	1,006	20	9.1	0.016	0.0003	0.00032	0.000006
Fingers Butte	227	7	9.8	0.004	0.0001	0.00008	0.000002
Graz Serv CCC3	283	8	12.9	0.006	0.0002	0.00012	0.000004
Grazing 2	267	8	11.9	0.005	0.0002	0.0001	0.000004
Houghland	609	18	13.6	0.014	0.0004	0.00028	0.000008
USGS-009	2,700	314	23	0.11	0.01	0.0022	0.0002
USGS-105	29,900	1,200	15	0.76	0.03	0.0152	0.0006
USGS-108	21,700	600	15	0.55	0.02	0.011	0.0004
USGS-109	1,480	74	16	0.04	0.002	0.0008	0.00004
USGS-106	274,000	7,100	15	7	0.2	0.14	0.004

Table B-1. (continued).

Location	Insitu $^{36}\text{Cl}/\text{Cl}$	+/-	Chloride (mg/L)	^{36}Cl (10^{10} Atoms)	+/-	^{36}Cl (pCi/L)	+/-
USGS-011	1,680	151	14	0.04	0.004	0.0008	0.00008
USGS-014	2,024	145	21	0.073	0.005	0.00146	0.0001
USGS-088	428	47	90	0.065	0.007	0.0013	0.00014
USGS-087	177,000	5,100	14	4.2	0.1	0.084	0.002
USGS-120	11,800	590	26	0.52	0.03	0.0104	0.0006
USGS-90	216,000	6,300	14	5.1	0.2	0.102	0.004
USGS-065	1,560,000	94,000	21	56	3	1.12	0.06
USGS-112	976,000	39,000	96	159	6	3.18	0.12
USGS-051	489,000	42,000	60	222	4	4.44	0.08
USGS-117	23,300	1,000	14	0.55	0.02	0.011	0.0004
USGS-083	468	21	12	0.01	0.0005	0.0002	0.00001
CFA-1	482,000	25,000	98	80	4	1.6	0.08
USGS-104	279,000	5,000	12	5.7	0.1	0.114	0.002
EBR-1	1,547	235	7	0.018	0.003	0.00036	0.00006
USGS-107	338	17	20	0.011	0.0006	0.00022	0.000012
USGS-038	750,000	45,000	118	150	9	3	0.18
USGS-116	475,000	17,000	71	57	2	1.14	0.04
USGS-121	2,540	220	14	0.06	0.005	0.0012	0.0001
USGS-058	125,000	5,000	12	2.5	0.01	0.05	0.0002
USGS-057	1,550,000	110,000	76	200	14	4	0.28
USGS-086	447	44	23	0.017	0.002	0.00034	0.00004
USGS-103	1,434	70	16	0.039	0.002	0.00078	0.00004
USGS-110	338	17	19	0.011	0.0006	0.00022	0.000012
MTR-test	35,500	5,000	13	0.78	0.11	0.0156	0.0022

a. This is a partial list from Beasley (1995). These wells are shown because they are in the area of interest.

The Cl-36/Cl ratio is plotted using data from the current study and data points in the area of interest from Beasley (1995) (Figure B-3). Although data from Beasley (1995) are about 13 years older than the current data set, many of the wells are within a factor of two to four for the wells sampled in both data sets. Given the many orders of magnitude that the data span, this difference is within acceptable limits for this map.

Although wells near INTEC were not sampled for this study, historical data from 1992 indicate Cl-36/Cl ratios of 400,000 to 2,180,000 near INTEC (Beasley 1995). This study focused on the Cl-36/Cl ratio in wells downgradient from INTEC, such as M12S and USGS-106, to evaluate upgradient influences on the RWMC. The Cl-36/Cl ratios in M12S and USGS-106 were 404,000 and 211,000, respectively. The Cl-36/Cl ratio of 211,000 for USGS-106 is similar to the ratio in 1992 of 274,000 (Beasley 1995).



Middle-1823, located southwest of RTC, has a Cl-36/Cl ratio of 44,000. Although Middle-1823 has not been sampled before for Cl-36/Cl ratio by AMS, USGS-065 located near the RTC was sampled in 1992 and had a Cl-36/Cl ratio of 1,560,000 (Beasley 1995). The Cl-36/Cl ratio appears to decrease more rapidly downgradient of the RTC, at least at Middle-1823, than at a similar distance downgradient from INTEC.

Wells near the RWMC show two different groups of Cl-36/Cl ratios. The wells on the north/east side of the RWMC have much higher (262,000 to 400,000) Cl-36/Cl ratios than wells south of the RWMC (300 to 15,000). The wells with the higher Cl-36/Cl ratios also are the wells with tritium contamination. On the northern and northeastern side, well M14S and the RWMC production well had Cl-36/Cl ratios of 402,000 and 262,000, respectively. The Cl-36/Cl ratio for the RWMC production well is higher than the previous result of 227,000 from 1992. In contrast, well M6S, located in the anion anomaly on the south side of the RWMC has a nearly background Cl-36/Cl ratio. In addition to well M6S, USGS-088 located on the south side of the RWMC was sampled in 1992 and also had a background Cl-36/Cl ratio. Well A11A31, located south of the RWMC, has a Cl-36/Cl ratio above background (15,000) but is more than an order of magnitude less than wells located on the north side of the RWMC. The Cl-36/Cl ratio for A11A31 is similar to the 1992 result for USGS-120 (Table B-1). The area of low Cl-36/Cl ratios extends up to wells M11S and M13S located east of the RWMC. Wells M11S and M13S have background to slightly above background Cl-36/Cl ratios.

Wells USGS-009, USGS-105, USGS-109, and USGS-108, located on the southern INL Site boundary, are well above background values of 320 to 640 (Bentley, Phillips, and Davis 1986). South of the INL Site boundary, wells USGS-124, USGS-125, USGS-011, and USGS-014 were all above background. As shown in Figure B-4, wells off-Site, USGS-011 and USGS-014, show relatively consistent concentrations, except for a spike in the 1980s, over an approximately 30- to 35-year period. Further south, the Houghland and Crossroads wells are above background and could show evidence of Site-derived Cl-36. Samples from both of these wells were also above background in 1992 (Beasley 1995). Wells CCC-3, Grazing-2, and Fingers Butte were at background levels in the current sampling event and also in 1992 (Table B-1 and Beasley 1995).

B-2.2 Discussion of Cl-36 Results

To evaluate the upgradient influences on the RWMC, the distribution of Cl-36 concentrations in the aquifer is used to evaluate flow paths. Both INTEC and RTC have Cl-36 plumes originating from them.

The Cl-36/Cl ratios suggest that wells on the northern and northeastern side of the RWMC are affected by INTEC plumes in contrast to wells on the south of the RWMC that have Cl-36 values similar to background or are slightly elevated above background. The insitu Cl-36/Cl ratios in wells on the north and northeastern side of the RWMC are similar to wells affected by the INTEC plume. The Cl-36/Cl ratios downgradient of INTEC in M12S and USGS-106 are three to six times higher than the ratio in Middle-1823 downgradient of RTC. Although the Cl-36/Cl ratio and the concentration of Cl-36 are lower in Middle-1823 than on the north side of the RWMC, RTC cannot be totally ruled out as an influence on the RWMC because this is an intermediate-depth well and the Cl-36 peak from RTC may have passed this location. The similar Cl-36/Cl ratios make it more difficult to accept RWMC as the source because it requires Cl-36 to migrate from the wastes in the Subsurface Disposal Area to the aquifer at approximately the same concentration as the INTEC plume.

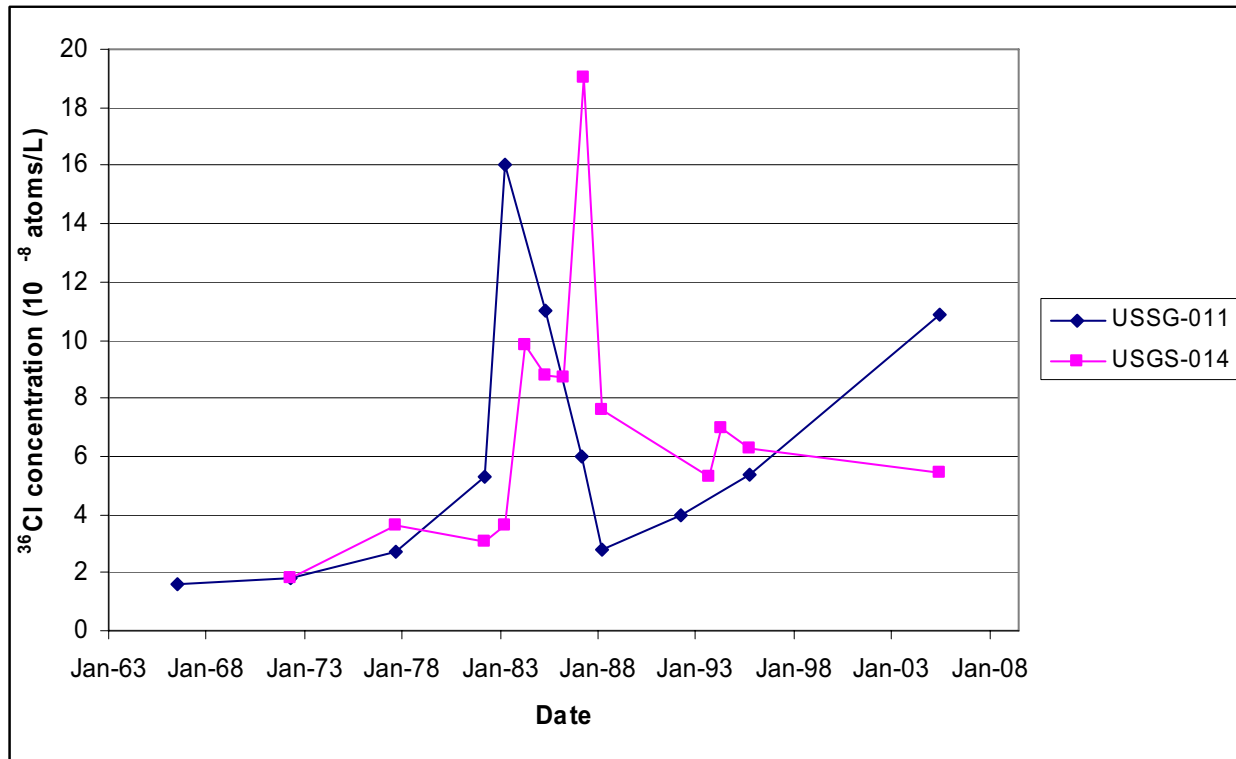


Figure B-4. Cl-36 trends in USGS-011 and USGS-014. Data prior to 2005 are from Cecil et al. (2000).

A comparison of tritium concentrations with the Cl-36 AMS data indicated that the Cl-36 plume can be traced well beyond the area of the tritium plume defined by the 500-pCi/L concentration for tritium (compare Figure B-2 with Figure B-3). South of the INL Site boundary, the wells USGS-124, USGS-125, USGS-011 and USGS-014 all show elevated Cl-36/Cl ratios and concentrations. Data trends for USGS-011 and USGS-014 show that Cl-36 concentrations peaked in 1983 for USGS-011 and peaked in 1987 for USGS-014 (Figure B-4). However, the most recent sample from USGS-011 appears to show a rise. Based on the first detection of Cl-36, contaminant/groundwater flow velocities of approximately 3 m/day were estimated for USGS-011 and USGS-014 south of the INL Site boundary (Cecil et al. 2000).

The Crossroads and Houghland wells have Cl-36/Cl ratios above background and could indicate the farthest traceable influence from facilities located in the INL Site. Based on the drop off in Cl-36 concentrations from USGS-011 and USGS-014 to the Crossroads and Houghland wells (Figure B-3), influences from the INL Site probably do not extend much beyond these locations even using the ultrasensitive AMS analytical method. However, the limited number of wells and the large distances between well locations make the degree of uncertainty difficult to determine. Although measurable using AMS methods, the Cl-36 concentrations in the Crossroads and Houghland wells are very dilute and several orders of magnitude below the MCL of 2,000 pCi/L.

B-3. STABLE ISOTOPE RESULTS AND DISCUSSION

The stable isotope data presented below are expressed in conventional delta (δ) notation in per mil (‰, parts per thousand) difference in the ratio of the less abundant isotope to the most abundant isotope in a sample relative to the same ratio in a known reference standard such as Vienna Standard Mean

Ocean Water (VSMOW) or Canyon Diablo Triolite (CDT) (Clark and Fritz 1997). The following equation is used:

$$\delta X_{\text{sample}} = [(R_{\text{sample}} - R_{\text{standard}}) / R_{\text{standard}}] \times 1000 \quad (\text{B-1})$$

where

δX = the isotope of interest ($\delta^{18}\text{O}$, $\delta^{34}\text{S}$ or $\delta^{15}\text{N}$)

R = the ratio of $^{18}\text{O}/^{16}\text{O}$, $^{15}\text{N}/^{14}\text{N}$ or $^{34}\text{S}/^{32}\text{S}$.

B-3.1 Nitrogen and Oxygen Isotope Ratios in Nitrate

The objective of the nitrogen and oxygen isotope ratio in the nitrate study was to track the influence of the INTEC nitrate contamination south of the CFA and to clarify the origin of an anion anomaly present on the south side of the RWMC (DOE-ID 2004). Prior to the WAG 10 study, the INTEC nitrate plume had been tracked into the CFA (ICP 2004). Recent data for nitrogen and oxygen isotope ratios in nitrate have indicated that the nitrate plume from INTEC has a distinct signature versus natural nitrate in the SRPA (ICP 2004). The purpose for using stable isotope ratios in nitrate rather than nitrate or chloride concentrations was to extend the discernable plume limits of the INTEC nitrate plume as the nitrate concentrations are diluted to concentrations marginally above background south of CFA.

The wells sampled for nitrogen and oxygen isotope ratios in nitrate are listed in Table B-2 and shown on Figure B-5. USGS-106 and M12S were sampled because they are probably within the INTEC plume and should yield a downgradient signature for INTEC. Wells M7S and M14S and the RWMC production well were sampled because they are contaminated with tritium that could be from INTEC, RWMC, or RTC. Wells M6S and M15S were sampled because these wells are within the anion anomaly south of the RWMC and because M6S has nitrate concentrations above local background conditions. Well M11S was sampled because it is located outside the tritium anomaly and the anion anomaly south of the RWMC. Well M13S was not sampled for nitrogen and oxygen isotope ratios because it has a chemistry similar to M11S and does not show tritium contamination. The Rifle Range well and Middle-1823 are located between RTC and RWMC and were sampled to provide a downgradient signature for RTC.

The analytical method used to determine the nitrogen and oxygen isotope ratios in nitrate are described in this appendix.

B-3.1.1 Nitrogen and Oxygen Isotope Ratio Results

The $\delta^{15}\text{N}$ results for the samples collected for the WAG 10 geochemical study ranged from +6.1 to +7.37 ‰, while the $\delta^{18}\text{O}_{\text{nitrate}}$ results ranged from -3.19 to -6.52 ‰ (Table B-2). To examine the potential sources of nitrate contamination, the $\delta^{15}\text{N}$ values were plotted versus the $\delta^{18}\text{O}$ values for nitrate (Figure B-6). The plot of $\delta^{15}\text{N}$ values versus the $\delta^{18}\text{O}_{\text{nitrate}}$ values shows that the WAG 10 samples plot in two groups with Middle-1823 plotting as a separated point (Figure B-6). The first group, M12S,

Table B-2. Stable isotope results for WAG 10 geochemical study.

Location	Nitrate		Sulfate	
	$\delta^{15}\text{N}$	$\delta^{18}\text{O}$	$\delta^{34}\text{S}$	$\delta^{18}\text{O}$
<u>SRPA wells</u>				
A11A31	— ^a	—	6.47	-4.2
M11S	6.5	-6.35	6.48	-1.29
M12S	6.23	-3.42	6.55	-0.55
M13S	—	—	6.82	-0.14
M14S	6.1	-3.9	6.98	-0.07
M15S	6.51	-6.52	6.29	-3.63
M1S	—	—	5.06	-4.09
M4D	—	—	5.14	0.64
M6S	6.65	-6.46	6.06	-5.62
M7S	6.3	-3.19	6.62	-0.05
Middle-1823	7.37	-5.26	7.04	2.08
Rifle Range	6.89	-6.37	6.38	0.91
<u>RWMC production well</u>	6.13	-4.44	6.96	-1.02
USGS-065	—	—	4.19	5.51
USGS-106	6.46	-4.46	—	—
<u>Perched well/lysimeters</u>				
D06-DL01	—	—	6.92	-3.8
D06-DL02	—	—	7.06	-4.25
8802D	—	—	6.63	-4.7

a. "—" means not analyzed.

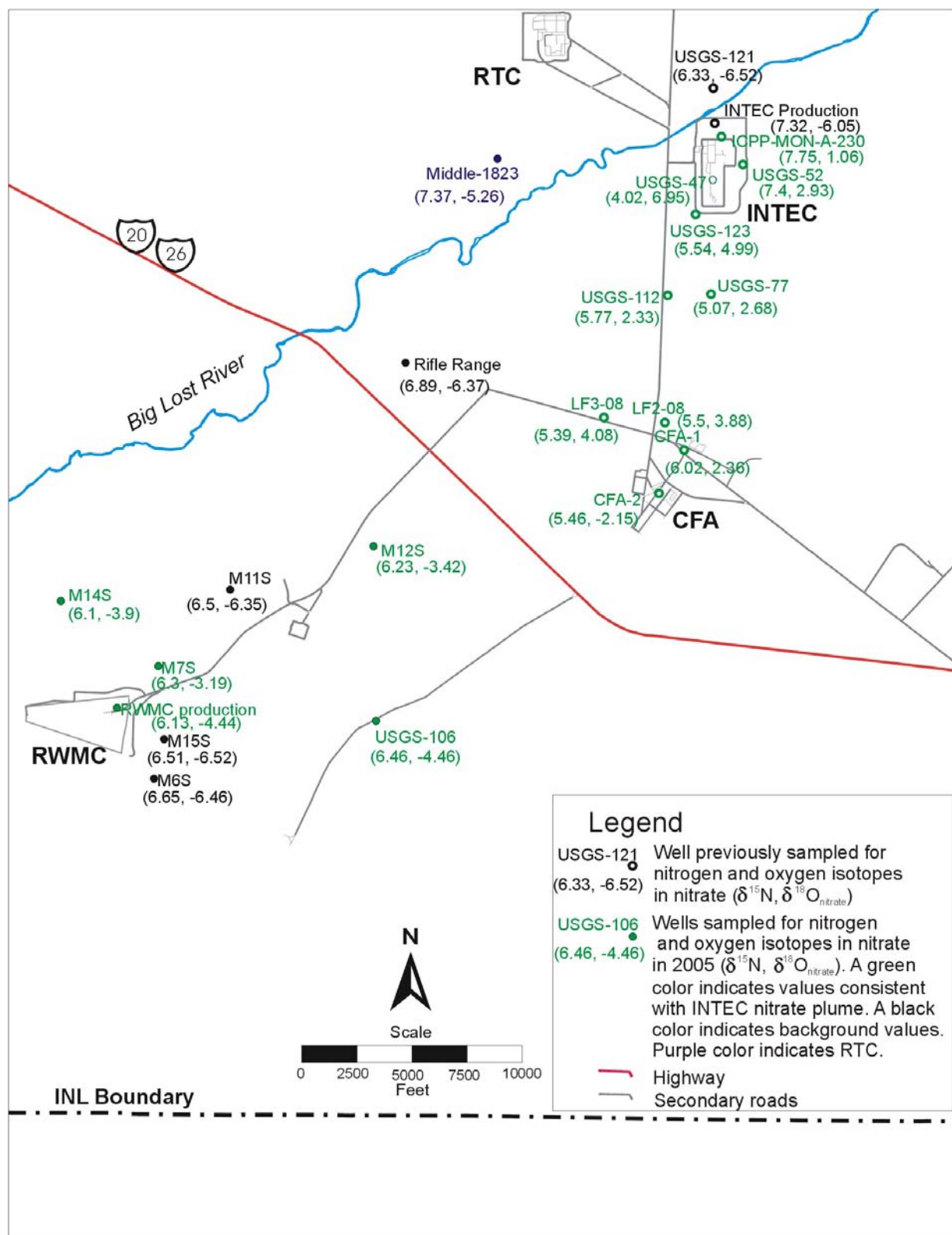


Figure B-5. Wells sampled for stable isotope ratios in nitrate and distribution of $\delta^{15}\text{N}$ and $\delta^{18}\text{O}_{\text{nitrate}}$ values.

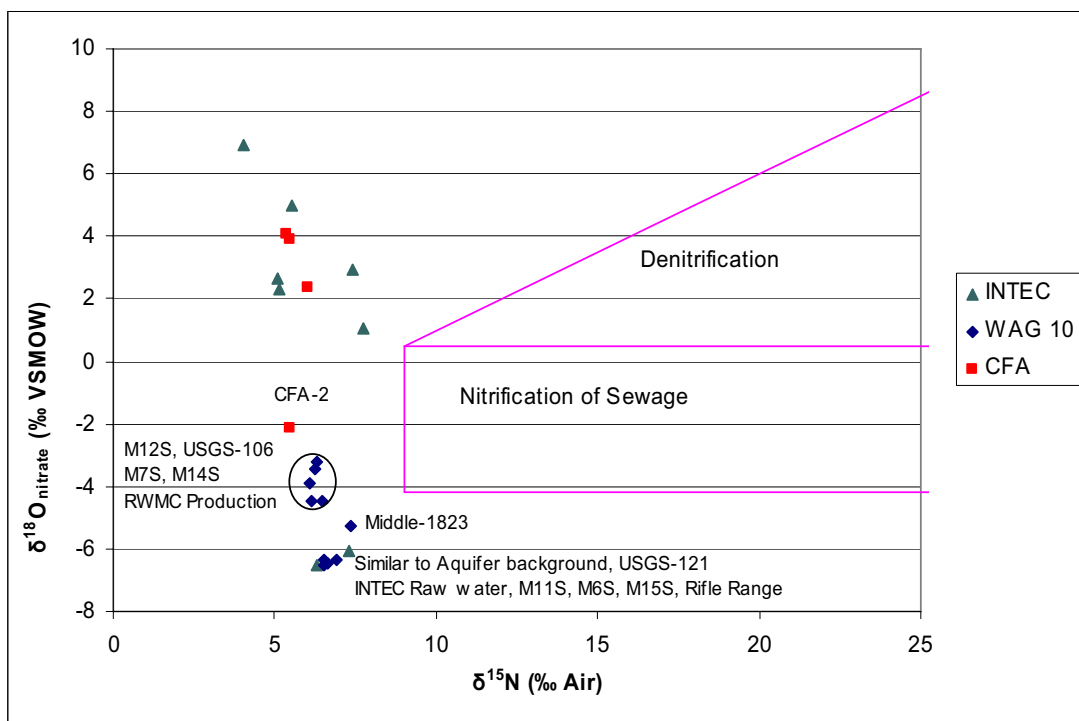


Figure B-6. Plot of $\delta^{15}\text{N} - \delta^{18}\text{O}$ for samples collected for this study and for INTEC and CFA.

USGS-106, M14S, M7S, and the RWMC production well, are represented by $\delta^{15}\text{N}$ values (+6 to +6.4 ‰) with $\delta^{18}\text{O}_{\text{nitrate}}$ from -3 to -4. This group of wells plots between values for background and the value for production well CFA-2. The second group plots similar to natural background values (nitrogen isotope ratios of 6 to 7 ‰ and $\delta^{18}\text{O}_{\text{nitrate}}$ of -6 to -7 ‰) as represented by well USGS-121 and the raw water supply for INTEC. The background group includes wells M11S, M15S, M6S, and Rifle Range. None of the samples appear to show a sewage influence based on the range for nitrification of sewage and denitrification of sewage determined for the INTEC perched water source geochemical study (EDF-5758). The $\delta^{15}\text{N}$ and the $\delta^{18}\text{O}_{\text{nitrate}}$ values for CFA landfill and production wells shown on Figure B-5 are from (ICP 2004).

B-3.1.2 Discussion of $\delta^{15}\text{N}$ and $\delta^{18}\text{O}_{\text{nitrate}}$ Results

The $\delta^{15}\text{N}$ data and $\delta^{18}\text{O}_{\text{nitrate}}$ data are discussed with respect to groundwater flow paths from INTEC and RTC and the potential source of nitrate in the anion anomaly south of the RWMC. Because of the small variation in the $\delta^{15}\text{N}$ data, the $\delta^{18}\text{O}_{\text{nitrate}}$ data are primarily used to differentiate groundwater flow paths and determine the source of the nitrate. Because of the oxidizing conditions and near-neutral pH in the SRPA, stable isotope ratios in nitrate should behave conservatively and the data should reflect the source of the nitrate.

The wells that plot together as a group on Figure B-6, M12S, USGS-106, M14S, M7S, and the RWMC production well, are all contaminated with tritium. If these wells are affected by INTEC, then they should plot between the background values for $\delta^{15}\text{N}$ and the $\delta^{18}\text{O}_{\text{nitrate}}$ and the value for CFA-2 due to dilution south of CFA-2. Wells M12S, USGS-106, M14S, M7S, and the RWMC production well plot between CFA-2 and background suggesting that their $\delta^{15}\text{N}$ and the $\delta^{18}\text{O}_{\text{nitrate}}$ values are consistent with dilution of the INTEC nitrate plume (Figure B-6). In addition, the above wells fall on a trend from INTEC to background (Figure B-6).

Another possibility to account for the $\delta^{18}\text{O}_{\text{nitrate}}$ values in M12S, USGS-106, M14S, M7S, and RWMC production well is that the nitrate originates from wastes in the RWMC. Nitrate from nitric acid would be expected to have $\delta^{15}\text{N}$ and $\delta^{18}\text{O}_{\text{nitrate}}$ values similar to the INTEC plume. The $\delta^{18}\text{O}_{\text{nitrate}}$ from nitric acid that has equilibrated or partially equilibrated with local water should fall within the range of 3 to 23 ‰ (EDF-5758). This $\delta^{18}\text{O}$ range is higher than background $\delta^{18}\text{O}_{\text{nitrate}}$ values (Figure B-6). On the basis of the $\delta^{15}\text{N}$ and $\delta^{18}\text{O}_{\text{nitrate}}$ values alone, a nitrate source from wastes in the RWMC cannot be ruled out.

The wells affected by the RTC tritium and sulfate plumes, Middle-1823 and the Rifle Range well, show background $\delta^{15}\text{N}$ and the $\delta^{18}\text{O}_{\text{nitrate}}$ values in the case of the Rifle Range well and only a slight variation from background for the $\delta^{18}\text{O}_{\text{nitrate}}$ value for Middle-1823. Based on the available data, the $\delta^{15}\text{N}$ and $\delta^{18}\text{O}_{\text{nitrate}}$ data collected in this study do not support a groundwater flow path from RTC to the RWMC.

The $\delta^{15}\text{N}$ and the $\delta^{18}\text{O}_{\text{nitrate}}$ data are also used to evaluate the source of the anion anomaly south of the RWMC. Both of the wells in the anion anomaly, M15S and M6S, have $\delta^{15}\text{N}$ and $\delta^{18}\text{O}_{\text{nitrate}}$ values similar to background. The background values also indicate that the nitrate in these wells did not originate from wastes buried in the RWMC as that nitrate should have a $\delta^{15}\text{N}$ and $\delta^{18}\text{O}_{\text{nitrate}}$ signature similar to a manufactured source of nitrate. The $\delta^{15}\text{N}$ and the $\delta^{18}\text{O}_{\text{nitrate}}$ values would also indicate that leakage from the sewage evaporation ponds at the RWMC is not the source of the anion anomaly as sewage samples would be expected to plot in the nitrification or denitrification fields shown on Figure B-6. The fields for sewage and denitrification of sewage are based on a literature review and data from the INTEC sewage lagoons (EDF-5758).

B-3.2 Sulfur and Oxygen Stable Isotope Ratios in Sulfate

The purpose of collecting the sulfur and oxygen isotope ratio in sulfate data is to evaluate groundwater flow paths in the INTEC/RTC/RWMC area and to determine the source of the elevated sulfate concentrations in the anion anomaly (both chloride and sulfate are elevated) on the south side of the RWMC. The wells sampled as part of this study are listed in Table B-2 and shown on Figure B-7. The idea for using the stable isotope data is that this data may be able to distinguish the sulfate plume further downgradient as the sulfate concentrations are diluted to concentrations marginally above background.

To determine the downgradient signature of INTEC, well M12S was sampled while wells USGS-065 and Middle-1823 were used to evaluate the downgradient signature from RTC. Wells M7S, M11S, M13S, M4D, M14S, and RWMC production well were sampled in the RWMC area. Wells M6S, M15S, and A11A31 within the anion anomaly south of the RWMC were sampled to evaluate the source of the elevated sulfate concentrations and provide insight to the origin of the associated chloride.

In addition to the above aquifer wells, a perched well and two lysimeters within the RWMC were sampled to aid in the identification of migration of leachate and the MgCl brine applied to roads at the RWMC. Lysimeters D06-DL01 and D06-DL02 were sampled to obtain $\delta^{34}\text{S}$ and $\delta^{18}\text{O}$ signatures for uranium and nitrate contamination from the RWMC. In addition to being impacted by the MgCl brine, these two lysimeters have anomalously high uranium concentrations and high nitrate concentrations (Koeppen et al. 2005). In addition, perched well 8802D was sampled because it has been impacted by the MgCl brine applied to the roads at the RWMC but does not show consistent contamination.

The analytical method used to determine the sulfur and oxygen isotope ratios in sulfate is described in Appendix A.

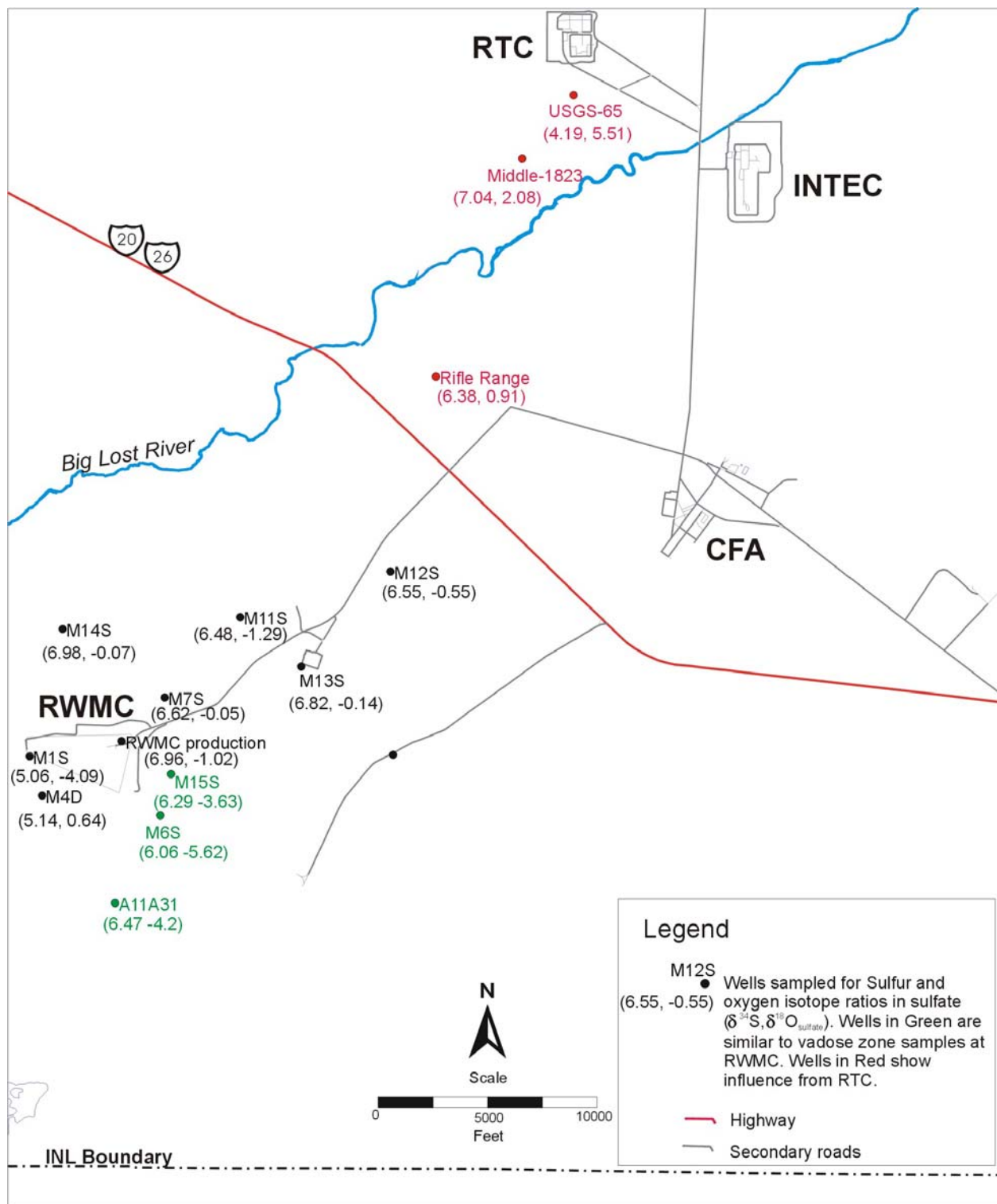


Figure B-7. Aquifer wells sampled for stable isotope ratios in sulfate and distribution of $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ values in aquifer.

B-3.2.1 Sulfur and Oxygen Isotope Results

The $\delta^{34}\text{S}$ results for the SRPA and perched water samples ranged from 5 to 7 ‰, while the $\delta^{18}\text{O}_{\text{sulfate}}$ results ranged from -6 to 6 ‰ (Table B-2). The aquifer samples showed a small range in $\delta^{34}\text{S}$ values of 4 to 7 ‰. In contrast, $\delta^{18}\text{O}_{\text{sulfate}}$ values for the aquifer samples showed more variability ranging from -5.6 to 5.6 ‰. The three perched water/lysimeter samples had $\delta^{34}\text{S}$ values of 6 to 7 ‰ and $\delta^{18}\text{O}_{\text{sulfate}}$ values of -3.8 to -4.7 ‰. A plot of $\delta^{34}\text{S}$ versus $\delta^{18}\text{O}_{\text{sulfate}}$ is typically used to distinguish sources of sulfate (Figure B-8). This plot indicates several sources of sulfate.

B-3.2.2 Discussion of $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ Results

Prior to this investigation, the USGS conducted a facility-wide sampling for $\delta^{34}\text{S}$, but that study did not include the $\delta^{18}\text{O}$ ratios in sulfate and did not include many wells in the RWMC area (USGS 1999). The USGS $\delta^{34}\text{S}$ data show a general trend of higher values on the eastern side of the INL Site to lower $\delta^{34}\text{S}$ values on the western side of the INL Site and provides a regional background base for $\delta^{34}\text{S}$ values (Figure B-9). These data indicate multiple sulfur sources across the INL Site that could be used to differentiate groundwater flow paths on the basis of sulfur sources on an INL Site facility scale, but the USGS data are not sufficiently detailed for the RTC-INTEC-RWMC area.

The sulfate sources in the current investigation are distinguished primarily on the basis of the $\delta^{18}\text{O}_{\text{sulfate}}$ data because the sulfur isotope data have a relatively narrow range of values. Like the stable isotope data for nitrate, the oxygen isotope ratios in sulfate have more variation than the sulfur isotope data, and, therefore, are more useful for differentiating sources. Under oxidizing conditions in the

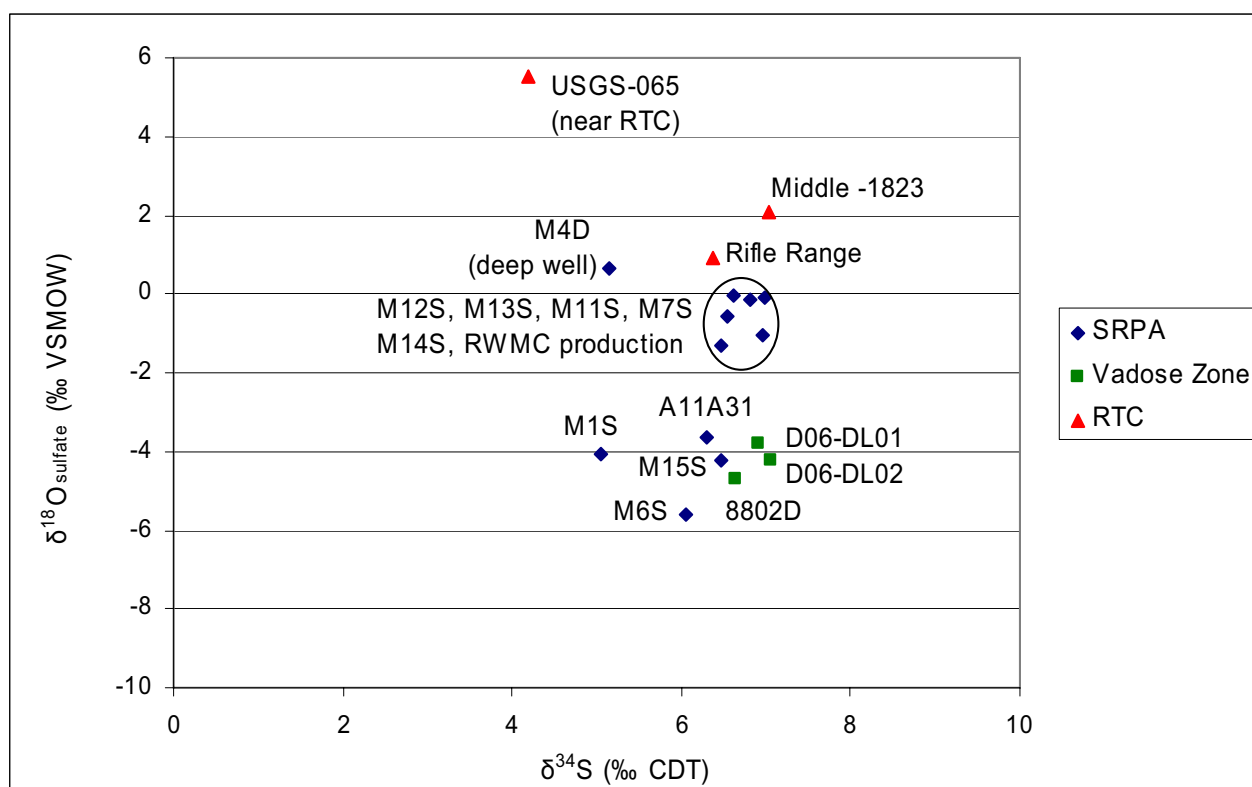


Figure B-8. Plot of $\delta^{34}\text{S}$ – $\delta^{18}\text{O}_{\text{sulfate}}$ values for samples collected.

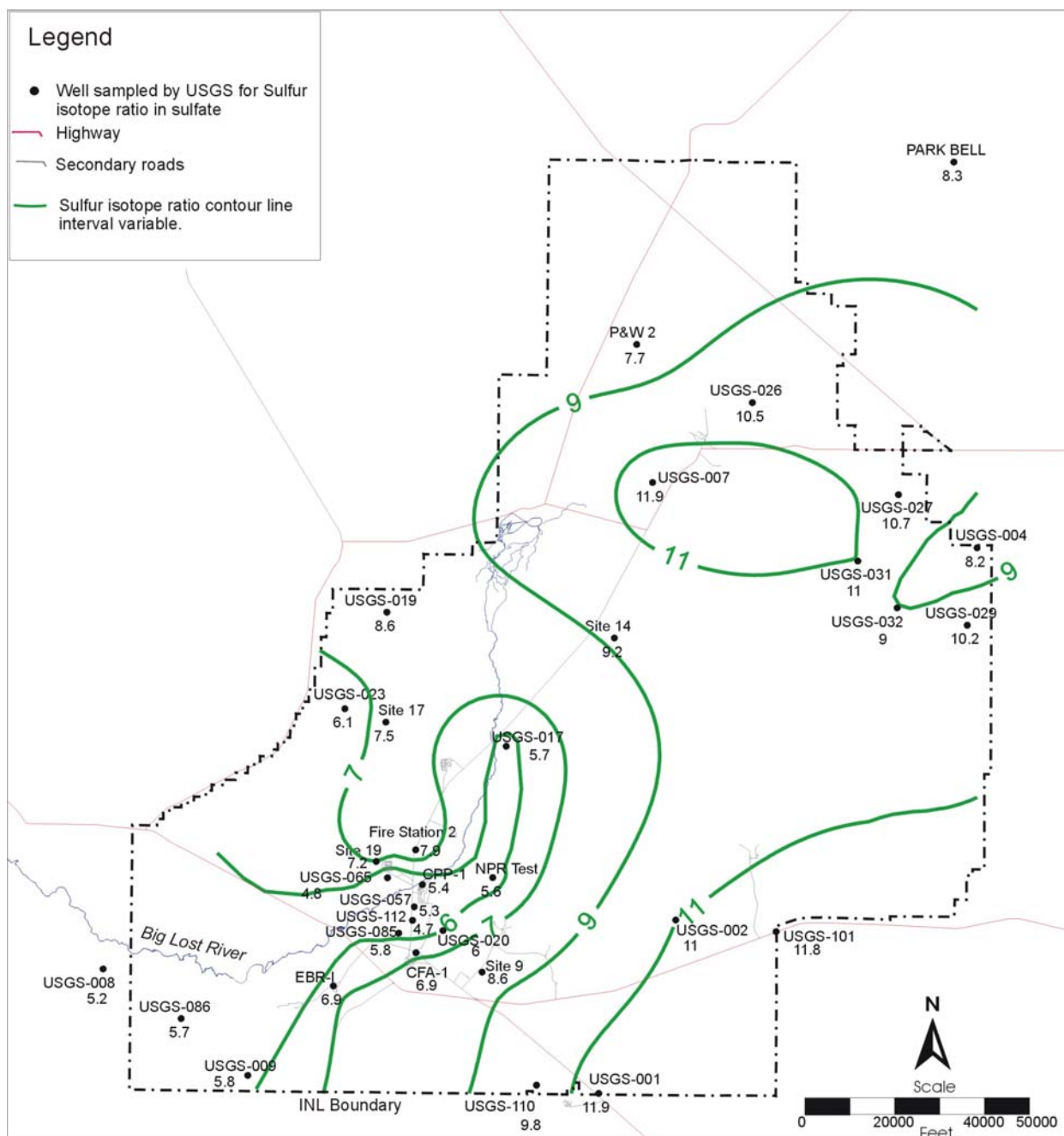


Figure B-9. Contour plot of $\delta^{34}\text{S}$ values from USGS (1999).

SRPA, isotope exchange is slow for ^{18}O exchange between sulfate and water at typical groundwater temperatures and neutral pH. The oxidizing conditions should also favor stable $\delta^{34}\text{S}$ values. Therefore, the $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ values should behave conservatively and the results should reflect the source of the sulfate. Although USGS-065 has a $\delta^{34}\text{S}$ value that is about 1.5 to 2 ‰ lower than the majority of the other samples, this difference does not appear to be large enough to differentiate sulfur sources over the groundwater flow path distances under consideration.

At least three sources of sulfate are indicated based on the plot of $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ (Figure B-8). These sources include the RTC, the vadose zone at the RWMC, and background. The sulfate plume from RTC is characterized by relatively higher $\delta^{18}\text{O}_{\text{sulfate}}$ values than background and the vadose zone at the RWMC. The Rifle Range well also had a higher $\delta^{18}\text{O}_{\text{sulfate}}$ value and suggests that the source of the tritium in this well is RTC. The elevated sulfate concentration with background chloride concentrations prior to the operation of the new INTEC percolation ponds also supports RTC as the source of the tritium in this well (Roddy and Koeppen 2004). It could also be argued that M4D, the deep well south of the RWMC, represents another source of sulfate based on its $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ values. However, M4D appears to be isolated from the shallow groundwater based on major ion chemistry (Roddy and Koeppen 2004).

The influence of sulfate contamination from RTC is not evident in the RWMC area based on the $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ values. Downgradient of the Rifle Range well, the influence of RTC is not apparent on the basis of $\delta^{18}\text{O}_{\text{sulfate}}$ values for the wells sampled.

Although $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ values upgradient of INTEC and RTC were not determined, wells M11S and M13S can be considered background since neither of these wells shows radiological contamination and M11S has a background nitrogen and oxygen isotope signature (see Section B-3.1). The wells with tritium contamination in vicinity of the RWMC, including M14S, M7S, and RWMC production, plot in the same vicinity as the background as represented by $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ values for M11S and M13S. In addition, well M12S, located hydraulically upgradient of the RWMC, also plots in the same vicinity as the tritium-contaminated wells near the RWMC. This suggests that M12S, M14S, M7S and the RWMC production well have the same sulfate source and that they are along the same groundwater flow path. These wells do not appear to be impacted by the vadose zone sources based on $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ values for the three vadose zone samples collected in the RWMC. Wells M14S, M7S, and RWMC production are consistent with $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ values for M12S. Well M12S is impacted by INTEC based on I-129, Cl-36, and nitrogen and oxygen isotope data. Thus, the $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ data are consistent with groundwater flow from INTEC impacting wells M14S, M7S, and RWMC production.

The sulfur and oxygen isotope ratios are also used to evaluate the source of the anion anomaly south of the RWMC represented by wells M6S, M15S, and A11A31. A couple of the possible sources for the anion anomaly south of the RWMC are leachate from the wastes within the RWMC or the MgCl brine applied to the roads at the RWMC. The MgCl brine dust suppressant was used between 1984 and 1993 and was determined to have migrated to a depth of at least 240 ft below the RWMC (Hull and Bishop 2003). The wells in the anion anomaly, M6S, M15S, and A11A31, have $\delta^{34}\text{S}$ and $\delta^{18}\text{O}_{\text{sulfate}}$ values that are more similar to the perched water well, 8802D, affected by the MgCl brine but with little evidence of leachate contamination (Figure B-8 and Table B-2). However, the values for all three vadose samples are similar and migration through waste does not appear to significantly alter the sulfur isotope signature for the two lysimeters sampled.

Although the wells in the anion anomaly have $\delta^{34}\text{S}$ and $\delta^{18}\text{O}_{\text{sulfate}}$ values that are most similar to 8802D, ideally, the sulfate source for M6S would have lower $\delta^{34}\text{S}$ and $\delta^{18}\text{O}_{\text{sulfate}}$ values than the values for M6S. The sulfate source must have lower $\delta^{34}\text{S}$ and $\delta^{18}\text{O}_{\text{sulfate}}$ than M6S to account for mixing the vadose zone water with aquifer water to produce the result seen in M6S. Water in the lower vadose zone could have $\delta^{34}\text{S}$ and $\delta^{18}\text{O}_{\text{sulfate}}$ values to be consistent with the data for M6S, but a sample was not obtained from the lower vadose zone at the RWMC. Based on the available $\delta^{34}\text{S}$ and $\delta^{18}\text{O}_{\text{sulfate}}$ values, the MgCl brine is the best source to account for the anion anomaly, but this interpretation is not definitive. An as-yet-unidentified source could possibly be responsible for the anion anomaly south of the RWMC.

B-4. INTEGRATED DISCUSSION OF GROUNDWATER FLOW PATHS

This discussion integrates the results and data interpretations for Cl-36, $\delta^{34}\text{S}$, $\delta^{18}\text{O}_{\text{sulfate}}$, $\delta^{15}\text{N}$, and $\delta^{18}\text{O}_{\text{nitrate}}$ along with historical data to evaluate groundwater flow paths and upgradient contaminant influences for the RWMC.

Previous studies by the USGS indicated the possibility of upgradient influences for the RWMC (Mann and Beasley 1994; Beasley, Dixon, and Mann 1998; and Busenberg, Plummer, and Bartholomay 2001). In addition, water level contour maps also indicated that the RWMC might be downgradient from RTC and INTEC (Figure B-2). I-129 was also detected at low concentrations in USGS-90, which is located near the RWMC (Mann and Beasley 1994). The occurrence of a low I-129 concentration near the RWMC suggested that the INTEC/RWMC plumes could be commingling. The interpretation of the I-129 data is complicated because I-129 is also present in the wastes emplaced in the RWMC. Although a Cl-36 plume originates from both RTC and INTEC, I-129 appears to originate from INTEC but not from RTC (Mann and Beasley 1994). Tc-99 was detected in the RWMC production well, which is consistent with the low-detection-limit I-129 data suggesting that a groundwater flow path extends from INTEC to the RWMC and that INTEC/RWMC plumes could be commingling. The interpretation of flow paths is complicated because Tc-99, like I-129, is also present in the wastes emplaced in the RWMC.

Sampling performed in 1991 and 1992 identified an I-129 plume extending from INTEC to south of the INL Site boundary, but an I-129 plume was not identified at the RTC (Mann and Beasley 1994). Sampling of Magic Valley wells and springs south of the INL Site from 1992 to 1994 indicated background I-129 concentrations (Cecil, Hall, and Green 2003). The previous Cl-36/Cl results show Cl-36 plumes from both INTEC and RTC extending several miles south of the INL Site boundary (Beasley 1995; Cecil et al. 2000). Sampling and analysis for Tc-99 using the low-detection-limit thermal ionization mass spectrometry method indicated a plume from INTEC extending past the southern boundary of the INL Site (Beasley, Dixon, and Mann 1998).

In addition to the radiological analytes discussed above, the USGS has mapped concentrations of chlorofluorocarbons (CFCs) in the SRPA (Busenberg, Plummer, and Bartholomay 2001). The CFC analyses were done to estimate the age of groundwater beneath the INL Site, but they indicated the presence of several CFC anomalies that could potentially be used as groundwater flow tracers. The CFC study indicated a plume of dichlorodifluoromethane (F-12) originating from INTEC and a 1,1,2-trichloro-1,2,2-trifluoroethane (F-113) plume originating at the RWMC. The pattern of F-12 concentrations in the aquifer matches with that of the radiological contaminants. The F-113 data suggest a potential volatile organic compound plume extending past the INL Site boundary, but the concentrations are very low and required special detection methods (Busenberg, Plummer, and Bartholomay 2001).

The current data for Cl-36, I-129, $\delta^{34}\text{S}$, $\delta^{18}\text{O}_{\text{sulfate}}$, $\delta^{15}\text{N}$, and $\delta^{18}\text{O}_{\text{nitrate}}$ along with the historical data are consistent with INTEC as the source of the tritium and other contaminants on the northern and eastern sides of the RWMC. This implies that preferential groundwater flow pathways in the aquifer bypass the wells M11S and M13S located on a direct flow path from INTEC to the RWMC area based on water level contours (see Figure B-2). Previously, the absence of tritium in M11S, M13S, and EBR-I was interpreted as indicating that the INTEC plume was separate from the RWMC plume (Holdren et al. 2002). The preferential pathway effect appears to also occur south of CFA at USGS-127 and USGS-083 since these wells are in a direct groundwater pathway from INTEC, but neither well has tritium and USGS-104 south of these wells has tritium. The preferential pathway effect also appears to occur near the location of the

new INTEC percolation ponds. Tritium occurs in ICPP-MON-A-167 and the Rifle Range well, but tritium is not detected in ICPP-MON-A-166, which is located between wells showing tritium contamination (Roddy and Koeppen 2004). Because of the potential for preferential flow paths to bypass areas as represented by single or multiple wells, the absence of contamination cannot be the sole basis to evaluate the extent or source of contamination.

Carbon tetrachloride has been detected in wells with tritium contamination, and this association was previously interpreted as indicating that the RWMC tritium plume originates from wastes within the RWMC because both carbon tetrachloride and tritium can migrate in the vapor phase. However, the distribution of carbon tetrachloride in the aquifer forms a circular pattern centered on the RWMC while the tritium occurs on the northern and northeastern sides of the RWMC. The carbon tetrachloride forms a pattern around the RWMC that is typical of a vapor plume superimposed on local groundwater gradients, but the tritium does not.

Although the evidence suggests INTEC as the source of the tritium on the northern side of the RWMC, I-129, Cl-36, tritium, and nitrate are also present in the wastes buried in the Subsurface Disposal Area. The $\delta^{18}\text{O}_{\text{nitrate}}$ values in M14S, M7S, and the RWMC production well could also be that the nitrate originates from wastes in the RWMC. However, the $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ data do not support migration through the wastes in the RWMC since they are consistent with upgradient wells affected by the INTEC. Although Cl-36 and I-129 were also in the wastes deposited into the RWMC, the probability that they would occur at concentrations that are consistent with the INTEC plume is small. Although many contaminants are similar between the RWMC and the upgradient facilities, the fact that multiple contaminants all appear to favor an upgradient source, in particular INTEC, makes the case for the RWMC as the source doubtful.

Flow paths south of the INL Site were examined for model calibration purposes and to evaluate the potential for off-Site contaminant influences. A Cl-36 plume extending south of the INL Site boundary has been identified (Beasley et al. 1993; Beasley 1995; Cecil et al. 2000). Plume concentrations decrease rapidly south of the INL Site boundary with concentrations more than five orders of magnitude below MCLs based on the wells sampled. Based on current and historical results from the wells sampled, only very low levels of contaminants are detectable using special methods (AMS) south of the INL Site boundary. In general, the shape of the plume seems to agree with the groundwater level contour map, but, as noted above, preferential pathways may bypass areas within the overall area of the Cl-36 plume.

The stable isotope data are used to evaluate the source of the anion anomaly south of the RWMC. Possible sources for the anion anomaly south of the RWMC are leachate from the wastes within the RWMC, MgCl brine applied to the roads at the RWMC, or the sulfate plume from the RTC. The brine dust suppressant was used between 1984 and 1993 and was determined to have migrated in the vadose zone to a depth of at least 240 ft below the RWMC (Hull and Bishop 2003). The wells in the anion anomaly, M6S, M15S, and A11A31, have $\delta^{34}\text{S}$ and the $\delta^{18}\text{O}_{\text{sulfate}}$ values that are more similar to the perched water well, 8802D, affected by the MgCl brine but with little evidence of other contamination (Figure B-8), but the values for all three vadose samples are similar. The $\delta^{15}\text{N}$ and the $\delta^{18}\text{O}_{\text{nitrate}}$ values for wells M15S and M6S are similar to background. The background values also indicate that the nitrate in these wells did not originate from wastes buried in the RWMC, as that nitrate should have a $\delta^{15}\text{N}$ and the $\delta^{18}\text{O}_{\text{nitrate}}$ signature similar to a manufactured source of nitrate. This is also supported by the near-background Cl-36/Cl value at M6S, indicating that the elevated anion concentrations are probably not due to migration through waste in the RWMC. The $\delta^{15}\text{N}$ and the $\delta^{18}\text{O}_{\text{nitrate}}$ values also indicate that leakage from the sewage evaporation ponds at the RWMC is not the source of the anion anomaly, as sewage samples would be expected to plot in the nitrification or denitrification fields shown on Figure B-6, based on a literature review and data from the INTEC sewage lagoons (EDF-5778).

B-5. SUMMARY AND CONCLUSIONS

The previously collected data and the data collected for this study support the premise that the source of the tritium on the north side of the RWMC is due to migration of contaminants from INTEC. The Cl-36 and stable isotope data are all consistent with an INTEC source, but this conclusion will need to be confirmed by the I-129 data collected for the geochemical study. Previous USGS studies using I-129, Tc-99, and freons support this conclusion. Evidence for commingling of RTC and INTEC plumes was not able to be determined but will be evaluated when the I-129 data are available. Commingling of the RWMC carbon tetrachloride plume and the INTEC plumes was indicated.

Because of the potential for preferential flow paths to bypass individual wells or areas, a full geochemical analysis, along with contaminant data, is needed to evaluate groundwater flow paths and extent of contamination.

The anion anomaly on the south side of the RWMC could be from migration of the MgCl brine applied to the roads in the RWMC based on the stable isotope ratios in sulfate and the lack of other contaminants. However, the sulfur and oxygen isotope data are not definitive. The nitrogen and oxygen isotope data and the Cl-36/Cl ratio data indicate background values present in M6S centered in the anion anomaly. If the source of this anomaly is the MgCl brine, then this would suggest that the brine migrated to the aquifer without passing through buried waste in the RWMC.

The Cl-36 data indicate that concentrations dilute rapidly south of the INL Site boundary. Using the AMS method, groundwater flow paths can be traced as far south as the Houghland well or about 13 miles south of the INL Site boundary. At this well, the Cl-36 concentration is about three times background but more than five orders of magnitude below the Cl-36 MCL. Due to the large dilution in Cl-36 concentration that occurs south of the INL Site boundary, contaminants from the INL Site should not have an impact on wells in the Magic Valley. Additional analysis of contaminant impacts south of the INL Site boundary will be included in the OU 10-08 RI/FS.

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Appendix C

Sitewide Groundwater Level Data from the June 2005 Measuring Event

Appendix C

Sitewide Groundwater Level Data from the June 2005 Measuring Event

This appendix presents the field data from water level measurements taken in June 2005. Table C-1 shows the depths to water corrected for stick-up and e-line calibration and for borehole deviation. Table C-2 shows vertical gradient calculations. These tables (in Excel) are also provided on the compact disc attached to the inside back cover of this report.

Table C-1. Water level measurements for June 2005.

Well Name	Alias	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
<u>Aquifer wells</u>										
ANL-MON-A-013		1075	06/15/2005	5120.37	4.61	650.81	646.20	0.06	0.00	4474.11
ANP-10		78	06/13/2005	4786.20	1.40	232.82	231.42	0.05	0.00	4554.73
ANP-4	IET Disposal	72	06/13/2005	4791.51	3.27	225.80	222.53	0.04	0.00	4568.94
ANP-5		73	06/13/2005	4873.99	0.59	305.72	305.13	0.06	0.00	4568.80
ANP-6		74	06/13/2005	4797.49	2.14	228.05	225.91	0.04	0.00	4571.54
ANP-7		75	06/13/2005	4935.41	1.11	366.76	365.65	0.07	0.00	4569.69
ANP-8		76	06/13/2005	4789.38	2.57	225.31	222.74	0.04	0.00	4566.60
ANP-9		77	06/13/2005	4786.42	1.95	234.62	232.67	0.05	0.00	4553.70
ARA-MON-A-001		1003	06/13/2005	5034.30	3.08	599.23	596.15	0.32	0.47	4438.30
ARA-MON A-002		1004	06/13/2005	5037.40	3.01	602.42	599.41	0.32	0.10	4437.77
ARA-MON A-03A		1006	06/13/2005	5050.10	3.22	613.39	610.17	0.33	0.12	4439.72
ARA-MON-A-004		1007	06/13/2005	5064.60	3.06	627.61	624.55	0.34	0.08	4439.79
ARBOR-TEST		82	06/14/2005	5163.98	0.91	615.03	614.12	0.24	0.00	4549.62
CERRO GRANDE		92	06/13/2005	4979.30	1.32	561.82	560.50	-0.05	0.00	4418.85
CFA-1931		1931	06/13/2005	4931.25	2.33	487.55	485.22	0.25	0.23	4446.01
CFA-1932		1932	06/13/2005	4938.08	2.66	494.00	491.34	0.25	0.25	4446.74
CFA-MON-A-001		1077	06/13/2005	4936.44	1.73	498.12	496.39	0.27	0.04	4439.82
CFA-MON-A-002		1078	06/22/2005	4932.24	2.59	494.16	491.57	0.26	0.05	4440.46
CFA-MON-A-003		1089	06/13/2005	4930.31	2.34	493.76	491.42	0.27	0.03	4438.65
COREHOLE #1		96	06/13/2005	5370.07	2.49	944.78	942.29	0.00	0.13	4427.91
COREHOLE #2A		97	06/14/2005	4787.20	1.02	219.14	218.12	-0.02	0.06	4569.16
DH1B		147	06/14/2005	4792.33	3.04	287.30	284.26	-0.02	0.00	4508.09
DH2A		148	06/14/2005	4794.85	0.53	288.64	288.11	-0.03	0.00	4506.77
FET-3		156	06/13/2005	4782.69	2.67	216.97	214.30	0.08	0.00	4568.31
FIRE STATION WELL		158	06/14/2005	4901.13	1.45	439.91	438.46	0.04	0.00	4462.63
FOSTER-1		--	06/23/2005	5030.00	0.53	522.28	521.75	0.28	0.00	4507.97
FOSTER-2		--	06/23/2005	5120.00	0.33	622.35	622.02	0.32	0.00	4497.66
GIN-1		159	06/13/2005	4786.92	1.27	222.25	220.98	0.04	0.00	4565.90
GIN-2		160	06/13/2005	4786.41	1.33	221.33	220.00	0.04	0.00	4566.37

Table C-1. (continued).

Well Name	Alias	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
GIN-3		161	06/13/2005	4786.57	1.99	222.09	220.10	0.04	0.00	4566.43
GIN-4		162	06/13/2005	4786.62	1.51	221.67	220.16	0.04	0.00	4566.42
GIN-5		163	06/13/2005	4786.73	1.67	221.72	220.05	0.04	0.00	4566.64
HWY-2		183	06/14/2005	5216.21	1.45	736.11	734.66	0.29	0.00	4481.26
ICPP-1782		1782	06/14/2005	4922.79	2.56	478.28	475.72	0.26	0.00	4446.81
ICPP-1783		1783	06/14/2005	4921.51	2.38	476.82	474.44	0.26	0.00	4446.81
ICPP-1800		1800	06/14/2005	4920.66	2.39	475.98	473.59	0.26	0.00	4446.81
ICPP-1829		1829	06/14/2005	4919.89	2.56	475.40	472.84	0.26	0.00	4446.79
ICPP-1831		1831	06/14/2005	4923.67	2.63	479.23	476.60	0.26	0.00	4446.82
ICPP-MON-A-022		1092	06/14/2005	4907.10	3.10	461.88	458.78	0.25	0.04	4448.11
ICPP-MON-A-164B		1349	06/15/2005	4948.66	3.05	504.75	501.70	0.27	0.00	4446.69
ICPP-MON-A-164C		1350	06/15/2005	4951.89	3.23	508.10	504.87	0.27	0.02	4446.77
ICPP-MON-A-165		1351	06/22/2005	4949.51	3.34	360.17	356.83	0.21	0.01	4592.48
ICPP-MON-A-166		1352	06/15/2005	4956.00	2.86	512.15	509.29	0.27	0.04	4446.48
ICPP-MON-A-167		1383	06/15/2005	4946.71	3.12	DRY	NA	NA	NA	NA
ICPP-MON-A-230		1442	06/13/2005	4912.41	2.38	467.00	464.62	0.25	0.00	4447.54
ICPP-MON-P-019	MW-18	1187	06/13/2005	4913.74	4.25	470.62	466.37	0.25	0.00	4447.12
LF2-08		196	06/13/2005	4931.72	1.62	489.45	487.83	0.25	3.00	4446.64
LF2-09		197	06/13/2005	4932.23	2.73	DRY	NA	NA	NA	NA
LF2-10		198	06/13/2005	4932.48	1.81	490.35	488.54	0.25	0.75	4444.44
LF2-11		199	06/13/2005	4928.36	1.90	483.70	481.80	0.25	0.09	4446.40
LF2-12		724	06/13/2005	4936.20	1.15	DRY	NA	NA	NA	NA
LF3-08		207	06/13/2005	4940.22	1.55	500.18	498.63	0.26	5.18	4446.51
LF3-09		726	06/13/2005	4941.08	2.37	DRY	NA	NA	NA	NA
LF3-10		727	06/13/2005	4942.78	2.79	DRY	NA	NA	NA	NA
M1S		765	06/13/2005	5011.09	3.70	594.47	590.77	0.00	0.19	4420.51
M3SA		766	06/13/2005	5016.16	2.66	597.83	595.17	0.00	0.19	4421.18
M4D		767	06/13/2005	5022.53	3.25	604.59	601.34	0.00	0.49	4421.68
M6S		768	06/13/2005	5065.76	3.52	648.99	645.47	0.00	0.02	4420.31
M7S		769	06/14/2005	5004.85	3.78	586.75	582.97	0.00	0.19	4422.07
MIDDLE 2051		2051	06/28/2005	5000.22	2.20	570.81	568.61	-568.61	0.10	4431.61

Table C-1. (continued).

Well Name	Alias	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
MIDDLE 1823		1823	06/13/2005	4939.36	2.47	494.84	492.37	0.25	0.00	4446.74
MTR-TEST		231	06/14/2005	4917.15	0.51	469.69	469.18	0.24	0.02	4447.75
NONAME-1	TAN-EXP 1	236	06/13/2005	4784.56	1.52	219.21	217.69	0.04	0.00	4566.83
NPR-TEST		239	06/14/2005	4933.15	3.41	476.05	472.64	0.04	0.00	4460.46
NRF-MON-A-010	NRF-10	1081	06/15/2005	4853.10	3.32	390.56	387.24	0.15	0.02	4465.73
NRF-MON-A-012	NRF-12	1083	06/15/2005	4850.83	2.44	387.44	385.00	0.15	0.03	4465.71
NRF-MON-A-013	NRF-13	1084	06/15/2005	4843.59	3.24	378.66	375.42	0.14	0.01	4468.04
NTP-AREA 2	AREA-II	245	06/13/2005	5128.42	3.00	681.49	678.49	0.36	0.00	4449.57
OWSLEY-2		247	06/13/2005	4786.87	1.27	235.52	234.25	0.05	0.00	4552.57
P&W-1		248	06/13/2005	4895.61	1.59	328.17	326.58	0.06	0.00	4568.97
P&W-2		249	06/13/2005	4890.88	3.25	325.20	321.95	0.06	0.00	4568.87
P&W-3		250	06/13/2005	4885.34	3.62	319.62	316.00	0.06	0.02	4569.30
PBF-MON-A-001		1085	06/30/05	4906.15	2.38	453.87	451.49	0.25	0.02	4454.43
PBF-MON-A-003		1087	06/13/2005	4959.29	2.20	525.49	523.29	0.29	0.06	4435.78
PBF-MON-A-004		1094	06/14/2005	4939.66	3.38	503.46	500.08	0.27	0.06	4439.36
PBF-MON-A-005		1095	06/22/2005	4976.13	2.52	265.01	262.49	0.17	0.00	4713.47
						(see Note 1)				
PSTF-TEST		256	06/13/2005	4786.37	1.89	221.00	219.11	0.04	0.00	4567.22
RWMC-MON-A-013	A11A31	906	06/13/2005	5065.40	3.31	650.11	646.80	0.00	0.13	4418.73
RWMC-MON-A-066	OW-2	1132	06/13/2005	5043.70	2.52	626.88	624.36	0.00	0.07	4419.41
RWMC-MON-A-162	M17S	1327	06/13/2005	5011.73	1.80	NM	NA	NA	NA	NA
						(see Note 2)				
SITE-01A WATER TABLE		272	06/21/2005	5361.81	2.00	990.35	988.35	0.00	0.00	4373.46
SITE-06		274	06/14/2005	4836.17	1.84	371.56	369.72	-0.03	0.00	4466.48
SITE-09		275	06/13/2005	4926.03	2.95	484.37	481.42	0.26	0.00	4444.34
SITE-14		276	06/14/2005	4793.92	3.16	284.81	281.65	-0.03	0.00	4512.29
SITE-16		277	06/15/2005	5121.23	2.21	649.35	647.14	0.06	0.33	4474.36
SITE-17		278	06/13/2005	4880.51	2.88	412.35	409.47	-0.04	0.00	4471.08
SITE-19		279	06/13/2005	4926.33	1.57	479.89	478.32	0.25	0.00	4447.76
SOUTH-1835		1835	06/13/2005	5021.28	2.61	603.41	600.80	0.00	0.00	4420.48

Table C-1. (continued).

Well Name	Alias	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
SOUTH-MON-A-001	M11S	1212	06/14/2005	4995.63	1.81	572.84	571.03	0.00	0.09	4424.69
SOUTH-MON-A-002	M12S	1213	06/14/2005	4975.28	2.16	543.59	541.43	0.00	0.07	4433.92
SOUTH-MON-A-003	M13S	1214	06/14/2005	5026.85	2.66	608.26	605.60	0.00	0.00	4421.25
SOUTH-MON-A-004	M14S	1215	06/13/2005	5032.46	3.20	613.39	610.19	0.00	0.04	4422.31
SOUTH-MON-A-009	M15S	1338	06/13/2005	5019.20	2.92	601.21	598.29	0.00	0.00	4420.91
SOUTH-MON-A-010	M16S	1339	06/13/2005	5004.34	2.48	585.42	582.94	0.00	0.00	4421.40
STF-MON-A-003		1305	06/13/2005	4937.01	2.74	507.81	505.07	0.28	0.14	4431.80
STF-MON-A-004		1306	06/13/2005	4945.37	2.91	515.65	512.74	0.28	0.10	4432.45
STF-MON-A-01A		998	06/13/2005	4941.40	2.61	510.10	507.49	0.28	0.03	4433.66
STF-MON-A-02A		999	06/13/2005	4937.30	3.35	505.49	502.14	0.27	0.02	4434.91
TAN-04		343	06/13/2005	4801.32	2.31	235.08	232.77	0.09	0.00	4568.46
TAN-05		344	06/13/2005	4801.84	2.28	235.61	233.34	0.09	0.00	4568.41
TAN-06		746	06/13/2005	4786.87	1.85	220.41	218.56	0.04	0.00	4568.27
TAN-07		747	06/13/2005	4786.76	1.92	220.55	218.63	0.04	0.00	4568.09
TAN-08		345	06/13/2005	4790.37	0.98	224.10	223.12	0.04	0.01	4567.22
TAN-09		346	06/13/2005	4780.73	1.89	213.87	211.98	0.08	0.00	4568.67
TAN-10		347	06/13/2005	4780.32	2.48	213.95	211.47	0.08	0.00	4568.77
TAN-10A		348	06/13/2005	4780.70	1.84	213.92	212.08	0.08	0.00	4568.54
TAN-11		349	06/13/2005	4780.50	2.30	213.98	211.68	0.08	0.01	4568.75
TAN-12		748	06/13/2005	4780.65	2.19	213.89	211.70	0.08	0.00	4568.87
TAN-13A		749	06/13/2005	4780.57	1.94	215.27	213.33	0.08	0.00	4567.16
TAN-14		750	06/13/2005	4780.91	1.58	215.66	214.08	0.08	0.00	4566.75
TAN-15		751	06/13/2005	4786.92	1.58	222.90	221.32	0.09	0.00	4565.51
TAN-16		752	06/13/2005	4786.88	1.99	220.80	218.81	0.08	0.00	4567.99
TAN-17		728	06/13/2005	4789.59	3.06	225.06	222.00	0.04	0.00	4567.55
TAN-18		790	06/13/2005	4802.96	1.46	236.27	234.81	0.09	0.15	4568.21
TAN-1859		1859	06/13/2005	4783.09	2.15	NM (see Note 3)	NA	NA	NA	NA
TAN-1860		1860	06/13/2005	4782.27	2.72	216.28	213.56	0.08	0.00	4568.63
TAN-1861		1861	06/13/2005	4782.88	2.66	216.80	214.14	0.08	0.00	4568.66
TAN-19		791	06/13/2005	4803.39	2.25	237.10	234.85	0.09	0.03	4568.48

Table C-1. (continued).

Well Name	Alias	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
TAN-20		792	06/13/2005	4781.24	1.68	214.80	213.12	0.08	0.01	4568.05
TAN-21		793	06/13/2005	4787.31	1.95	222.40	220.45	0.04	0.03	4566.85
TAN-22A		795	06/13/2005	4787.08	1.75	220.69	218.94	0.08	0.01	4568.07
TAN-23A		797	06/13/2005	4787.16	1.52	220.77	219.25	0.08	0.13	4567.96
TAN-24A		799	06/13/2005	4788.64	2.49	220.38	217.89	0.04	0.01	4570.72
TANT-MON-A-048	TAN-48	1211	06/13/2005	4788.59	1.61	221.10	219.49	0.08	0.01	4569.03
TANT-MON-A-051	TAN-51	1316	06/13/2005	4786.79	1.81	220.22	218.41	0.08	0.01	4568.31
TANT-MON-A-052	TAN-52	1317	06/13/2005	4785.34	2.72	221.90	219.18	0.08	0.01	4566.09
TANT-MON-A-054	TAN-54	1340	06/13/2005	4786.63	2.76	221.36	218.60	0.08	0.00	4567.95
TANT-MON-A-055	TAN-55	1341	06/13/2005	4786.81	2.71	221.11	218.40	0.08	0.00	4568.33
TANT-MON-A-057	TAN-57	1343	06/13/2005	4788.03	2.34	226.85	224.51	0.04	0.00	4563.48
TCH-2 MON 1	TAN-CH2	729	06/13/2005	4790.88	1.22	215.87	214.65	0.04	0.00	4576.19
TAN-DD2		339	06/13/2005	4779.89	2.63	214.13	211.50	0.08	0.00	4568.31
TANT-INJ-A-003	TAN-31	1219	06/13/2005	4780.83	3.19	NM	NA	NA	NA	NA
						(see Note 4)				
TANT-MON-A-004		1100	06/13/2005	4782.11	2.75	213.29	210.54	0.04	0.02	4571.55
TANT-MON-A-006	TAN-32	1134	06/13/2005	4785.60	1.88	218.77	216.89	0.08	0.01	4568.64
TANT-MON-A-007	TAN-33	1135	06/13/2005	4801.14	2.48	231.88	229.40	0.09	0.02	4571.67
TANT-MON-A-008	TAN-34	1136	06/13/2005	4785.20	2.40	216.78	214.38	0.08	0.07	4570.81
TANT-MON-A-009	TAN-35	1137	06/13/2005	4784.53	2.43	216.15	213.72	0.08	0.03	4570.76
TANT-MON-A-010	TAN-36	1138	06/13/2005	4793.86	2.57	227.77	225.20	0.09	0.02	4568.59
TANT-MON-A-011	TAN-37	1163	06/13/2005	4783.31	1.93	215.61	213.68	0.08	0.09	4569.64
TANT-MON-A-015	TAN-41	1167	06/13/2005	4785.46	1.86	217.33	215.47	0.08	0.00	4569.91
TANT-MON-A-016	TAN-42	1168	06/13/2005	4802.04	2.20	234.01	231.81	0.09	0.00	4570.14
TANT-MON-A-017	TAN-43	1169	06/13/2005	4801.35	2.09	233.20	231.11	0.09	0.01	4570.16
TANT-MON-A-018	TAN-44	1170	06/13/2005	4800.24	2.25	232.22	229.97	0.09	0.01	4570.19
TANT-MON-A-019	TAN-45	1171	06/13/2005	4797.16	2.19	229.09	226.90	0.09	0.01	4570.18
TANT-MON-A-020	TAN-46	1172	06/13/2005	4795.93	1.88	227.77	225.89	0.09	0.00	4569.95
TANT-MON-A-025	TAN-26	1118	06/13/2005	4782.16	1.03	214.41	213.38	0.08	0.02	4568.72
TANT-MON-A-027	TAN-27	1009	06/13/2005	4780.43	1.98	213.70	211.72	0.08	0.03	4568.66
TANT-MON-A-028	TAN-28	1008	06/13/2005	4781.41	2.57	215.48	212.91	0.08	0.10	4568.52

Table C-1. (continued).

Well Name	Alias	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
TANT-MON-A-029	TAN-29	1010	06/13/2005	4781.20	2.82	215.39	212.57	0.08	0.02	4568.57
TANT-MON-A-030A	TAN-30A	1012	06/13/2005	4781.35	2.64	215.39	212.75	0.08	0.03	4568.55
TANT-MON-A-047	TAN-47	1314	06/13/2005	4788.68	1.81	222.37	220.56	0.09	0.07	4568.10
TANT-MON-A-050	TAN-50	1315	06/13/2005	4788.44	2.36	222.34	219.98	0.04	0.00	4568.42
TANT-MON-A-056	TAN-56	1342	06/13/2005	4787.32	2.62	223.56	220.94	0.04	0.04	4566.38
TANT-MON-A-058	TAN-58	1344	06/13/2005	4789.06	2.56	224.97	222.41	0.04	0.00	4566.61
TANW-MON-A-MW-2		1013	06/13/2005	4789.32	2.62	217.04	214.42	0.08	0.01	4574.83
TCH-1	TAN	337	06/13/2005	4779.02	2.49	212.65	210.16	0.08	0.00	4568.78
	COREHOLE									
TRA-06		808	06/13/2005	4927.10	1.07	481.00	479.93	0.25	0.19	4447.11
TRA-07		731	06/13/2005	4931.56	2.40	486.64	484.24	0.25	0.06	4447.13
TRA-08		732	06/13/2005	4934.93	1.55	490.08	488.53	0.25	0.63	4446.78
TSF-05	ANP-03	71	06/13/2005	4782.21	1.16	NM	NA	NA	NA	NA
						(see Note 5)				
USGS-001		450	06/13/2005	5022.71	1.41	596.10	594.69	-0.05	0.14	4428.21
USGS-002		451	06/14/2005	5125.99	1.29	670.25	668.96	0.26	0.26	4457.03
USGS-004		453	06/13/2005	4791.32	1.36	275.96	274.60	0.10	0.00	4516.62
USGS-005		454	06/14/2005	4937.79	2.71	480.12	477.41	0.04	0.00	4460.34
USGS-006		455	06/14/2005	4899.12	2.88	426.89	424.01	-0.04	0.00	4475.15
USGS-007		456	06/13/2005	4789.35	1.61	224.43	222.82	0.04	0.00	4566.49
USGS-008		457	06/14/2005	5195.57	1.64	775.64	774.00	0.00	0.00	4421.57
USGS-009		458	06/13/2005	5031.86	1.06	616.32	615.26	0.06	0.06	4416.61
USGS-011		460	06/14/2005	5067.22	2.31	661.04	658.73	0.06	0.00	4408.43
USGS-012		461	06/13/2005	4819.58	2.78	344.71	341.93	-0.03	0.00	4477.68
USGS-013		462	06/14/2005	5375.27	0.46	993.05	992.59	0.00	0.00	4382.68
USGS-014		463	06/13/2005	5133.80	0.64	722.66	722.02	0.00	0.00	4411.78
USGS-015		464	06/13/2005	4812.43	2.45	NM	NA	NA	NA	NA
						(see Note 6)				
USGS-017		466	06/13/2005	4834.01	3.26	369.82	366.56	-0.03	0.00	4467.48
USGS-018		467	06/14/2005	4804.82	2.46	284.83	282.37	-0.03	0.00	4522.47
USGS-019		468	06/14/2005	4800.62	2.78	284.27	281.49	-0.03	0.00	4519.16

Table C-1. (continued).

Well Name	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
USGS-020	469	06/15/2005	4916.36	2.05	473.04	470.99	0.26	0.07	4445.18
USGS-021	470	06/13/2005	4838.99	0.94	DRY	NA	NA	NA	NA
USGS-022	471	06/14/2005	5048.74	2.81	621.32	618.51	0.06	0.00	4430.17
USGS-023	472	06/14/2005	4884.67	3.75	416.95	413.20	-0.04	0.00	4471.50
USGS-024	473	06/13/2005	4795.82	1.16	228.43	227.27	0.09	0.00	4568.46
USGS-025	474	06/13/2005	4849.44	1.39	281.98	280.59	0.06	0.00	4568.79
USGS-026	475	06/13/2005	4789.53	1.29	221.95	220.66	0.04	0.00	4568.83
USGS-027	476	06/13/2005	4785.00	1.15	236.48	235.33	0.09	0.00	4549.59
USGS-028	477	06/13/2005	4772.38	1.09	243.75	242.66	0.09	0.00	4529.63
USGS-029	478	06/13/2005	4878.64	1.37	368.98	367.61	0.14	0.00	4510.89
USGS-030A	479	06/13/2005	4794.84	1.14	270.43	269.29	0.10	0.00	4525.45
USGS-030B	479	06/13/2005	4794.84	1.14	282.79	281.65	0.10	0.00	4513.08
USGS-030C	479	06/13/2005	4794.84	1.14	282.82	281.68	0.10	0.00	4513.05
USGS-031	480	06/13/2005	4786.31	1.23	264.97	263.74	0.10	0.00	4522.47
USGS-032	481	06/13/2005	4812.70	1.16	302.79	301.63	0.11	0.00	4510.96
USGS-034	483	06/15/2005	4929.19	2.38	484.60	482.22	0.26	0.07	4446.78
USGS-035	484	06/15/2005	4929.64	2.84	485.67	482.83	0.26	0.28	4446.83
USGS-036	485	06/15/2005	4929.20	2.43	484.74	482.31	0.26	0.05	4446.68
USGS-037	486	06/15/2005	4929.38	2.53	484.88	482.35	0.26	0.05	4446.82
USGS-038	487	06/15/2005	4929.63	2.64	485.23	482.59	0.26	0.06	4446.84
USGS-039	488	06/15/2005	4930.95	2.58	486.52	483.94	0.26	0.09	4446.84
USGS-040	489	06/13/2005	4916.16	2.41	470.95	468.54	0.25	0.32	4447.68
USGS-041	490	06/13/2005	4916.91	2.77	471.98	469.21	0.25	0.13	4447.57
USGS-042	491	06/13/2005	4917.94	2.11	472.22	470.11	0.26	0.08	4447.65
USGS-043	492	06/14/2005	4916.05	2.17	470.41	468.24	0.25	0.18	4447.74
USGS-044	493	06/14/2005	4917.93	2.81	472.81	470.00	0.26	0.01	4447.68
USGS-045	494	06/14/2005	4918.30	3.05	474.14	471.09	0.26	0.04	4447.00
USGS-046	495	06/14/2005	4919.10	4.20	475.42	471.22	0.26	0.03	4447.65
USGS-047	496	06/13/2005	4916.31	-1.34	467.31	468.65	0.25	0.02	4447.43
USGS-048	497	06/13/2005	4916.87	2.45	471.60	469.15	0.25	0.04	4447.51
USGS-049	498	06/13/2005	4914.19	1.46	DRY	NA	NA	NA	NA

Table C-1. (continued).

Well Name	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
USGS-051	500	06/14/2005	4918.74	3.45	474.12	470.67	0.26	0.00	4447.81
USGS-052	501	06/13/2005	4909.56	3.18	465.15	461.97	0.25	0.18	4447.51
USGS-057	506	06/14/2005	4922.49	3.29	478.77	475.48	0.26	0.04	4446.79
USGS-058	507	06/14/2005	4918.37	1.52	472.07	470.55	0.24	0.00	4447.58
USGS-059	508	06/13/2005	4913.43	1.45	466.96	465.51	0.25	0.16	4447.82
USGS-065	514	06/13/2005	4925.01	0.55	474.15	473.60	0.24	0.00	4451.16
USGS-067	516	06/14/2005	4913.93	3.01	469.18	466.17	0.25	0.00	4447.51
USGS-076	525	06/13/2005	4929.70	1.57	484.19	482.62	0.25	0.00	4446.83
USGS-077	526	06/14/2005	4921.79	3.49	478.43	474.94	0.26	0.01	4446.60
USGS-079	528	06/13/2005	4931.08	2.03	485.69	483.66	0.25	0.00	4447.17
USGS-082	531	06/15/2005	4906.99	2.90	462.06	459.16	0.25	0.02	4447.60
USGS-083	532	06/13/2005	4941.59	3.27	509.25	505.98	0.00	0.02	4435.63
USGS-084	533	06/13/2005	4937.90	1.73	492.62	490.89	0.25	0.01	4446.77
USGS-085	534	06/13/2005	4939.26	2.28	494.98	492.70	0.25	0.13	4446.43
USGS-086	535	06/14/2005	5077.04	2.01	658.44	656.43	0.06	0.10	4420.65
USGS-087	536	06/14/2005	5017.37	2.18	597.80	595.62	0.00	0.00	4421.75
USGS-088	537	06/13/2005	5021.26	3.07	602.78	599.71	0.31	0.37	4421.61
USGS-089	538	06/13/2005	5029.87	2.75	611.74	608.99	0.31	0.05	4420.62
USGS-090	539	06/13/2005	5011.77	0.00	NM	NA	NA	NA	NA
(see Note 7)									
USGS-097	546	06/13/2005	4858.95	2.65	395.85	393.20	-0.04	0.00	4465.78
USGS-098	547	06/15/2005	4883.29	2.92	428.54	425.62	0.04	2.52	4460.16
USGS-099	548	06/15/2005	4872.36	2.78	410.19	407.41	0.04	0.00	4464.91
USGS-100	549	06/14/2005	5158.51	1.54	687.18	685.64	0.27	0.09	4472.69
USGS-101	550	06/14/2005	5251.60	1.74	782.07	780.33	0.30	0.56	4471.52
USGS-102	551	06/13/2005	4850.81	3.12	388.01	384.89	-0.04	0.00	4465.96
USGS-103	552	06/13/2005	5007.41	1.51	591.05	589.54	-0.05	1.57	4419.49
USGS-104	553	06/14/2005	4988.65	4.26	566.83	562.57	0.00	0.17	4426.25
USGS-105	554	06/13/2005	5095.09	2.66	678.97	676.31	0.06	0.04	4418.75
USGS-106	555	06/13/2005	5015.36	2.98	597.59	594.61	0.00	0.05	4420.80
USGS-107	556	06/13/2005	4917.50	2.00	488.33	486.33	-0.04	0.00	4431.21

Table C-1. (continued).

Well Name	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
USGS-108	557	06/13/2005	5031.37	1.66	616.32	614.66	-0.05	2.30	4419.07
USGS-109	558	06/13/2005	5043.61	3.11	630.21	627.10	0.06	0.11	4416.56
USGS-110	559	06/13/2005	4999.84	2.45	573.63	571.18	-0.05	0.06	4428.77
USGS-112	561	06/14/2005	4927.84	3.61	487.07	483.46	0.26	2.80	4446.91
USGS-113	562	06/14/2005	4925.28	3.60	487.63	484.03	0.26	5.91	4446.90
USGS-114	563	06/14/2005	4920.09	3.57	481.61	478.04	0.26	4.85	4446.63
USGS-115	564	06/14/2005	4918.84	3.58	477.65	474.07	0.26	2.18	4446.69
USGS-116	565	06/14/2005	4916.03	3.89	472.53	468.64	0.25	0.18	4447.31
USGS-117	566	06/13/2005	5012.74	2.96	596.03	593.07	0.00	1.11	4420.78
USGS-118	567	06/13/2005	5012.40	3.25	594.54	591.29	0.00	0.17	4421.28
USGS-119	568	06/13/2005	5031.91	3.02	615.41	612.39	0.00	0.88	4420.40
USGS-120	569	06/13/2005	5040.58	2.56	624.92	622.36	0.00	0.87	4419.09
USGS-121	570	06/14/2005	4909.65	1.88	464.97	463.09	0.25	1.68	4447.99
USGS-122	571	06/13/2005	4913.76	1.92	468.58	466.66	0.25	0.53	4447.37
USGS-123	572	06/14/2005	4919.18	3.66	475.42	471.76	0.26	0.06	4447.22
USGS-128	1413	06/13/2005	4934.92	1.30	489.45	488.15	0.25	0.03	4446.55
USGS-130	1836	06/13/2005	4927.53	1.31	486.37	485.06	0.25	0.09	4442.31
USGS-131	1837	06/13/2005	4977.30	0.93	547.92	546.99	0.00	0.05	4430.36
USGS-OBS-A-124	USGS-124	06/13/2005	5102.34	2.10	691.49	689.39	0.00	1.29	4414.24
USGS-OBS-A-125	USGS-125	06/13/2005	5050.72	2.29	636.98	634.69	0.06	0.19	4416.16
USGS-OBS-A-126A	USGS-126A	06/13/2005	4988.69	2.47	422.24	419.77	0.08	0.09	4568.93
USGS-OBS-A-126B	USGS-126B	06/13/2005	4989.25	2.46	422.83	420.37	0.08	0.04	4568.84
USGS-OBS-A-127	USGS-127	06/13/2005	4956.44	1.83	516.62	514.79	0.28	0.10	4441.47
WATER SUPPLY FOR INEL-1	WSI-1	06/15/2005	4872.83	2.76	411.17	408.41	0.04	0.20	4464.58
<u>Perched water wells</u>									
PW-11	759	06/14/2005	4916.49	1.32	108.50	107.18	0.06	0.00	4809.25
USGS-053	502	06/14/2005	4922.14	1.14	70.53	69.39	0.04	0.00	4852.71
USGS-054	503	06/14/2005	4920.94	1.26	64.42	63.16	0.04	0.00	4857.74
USGS-055	504	06/14/2005	4919.15	2.08	69.97	67.89	0.04	0.00	4851.22

Table C-1. (continued).

Well Name	Alias	Well ID	Sample Date	Land Surface Elevation (ft)	Stick-up (ft)	Depth to Water from Measuring Point (ft)	Depth to Water (ft bbc)	E-line Correction (ft)	Deviation Correction (ft)	Water Level Elevation (ft amsl)
USGS-056		505	06/14/2005	4921.44	0.67	71.31	70.64	0.04	0.00	4850.76
USGS-060		509	06/14/2005	4918.26	1.78	67.47	65.69	0.04	0.00	4852.53
USGS-061		510	06/14/2005	4921.67	0.77	89.62	88.85	0.05	0.00	4832.77
USGS-062		511	06/14/2005	4921.28	1.85	136.55	134.70	0.06	0.00	4786.51
USGS-063		512	06/14/2005	4923.64	1.76	77.23	75.47	0.04	0.00	4848.13
USGS-066		515	06/14/2005	4920.77	1.36	184.34	182.98	0.10	0.00	4737.69
USGS-070		519	06/14/2005	4916.84	2.00	71.10	69.10	0.04	0.00	4847.70
USGS-072		521	06/16/2005	4920.65	1.14	142.08	140.94	0.01	0.00	4779.70
USGS-073		522	06/14/2005	4928.35	1.69	86.68	84.99	0.05	0.00	4843.31

Notes:

1. Measured through pumpline.
 2. Inaccessible: 90-degree bend in access line.
 3. Rad issue.
 4. Rad issue; e-line hung-up.
 5. Rad issue.
 6. Obstructed at 287.61.
 7. Pump stuck in well.
- NM = not measured.
NA = not applicable.

Table C-2. Wells used for vertical gradient evaluation.

Well ID	Land Surface or Brass Cap Elevation	Well Pair Designation ^a	Screen Top Depth (ft bls)	Screen Bottom Depth (ft bls)	Screen Separation (ft)	Screen Type	Horizontal Distance Between Wells (ft)	Water Level Date, INL Data	Water Level Elevation	Water Level Difference (ft) ^b	Vertical Gradient (ft/ft) ^b
77	4786.42	Shallow	236.64	314		Perforated	1,378	06/13/2005	4554.73	3.14	0.013143
78	4786.20	Deep	552.44	676	239	Perforated		06/13/2005	4557.87		
196	4931.72	Shallow	485	495		Slotted screen	100	06/13/2005	4446.64	-2.20	-0.00966
197	4932.23	Shallow	469.6	497		Slotted screen	101	06/13/2005	dry		
198	4932.48	Deep	725	735	228	Perforated		06/13/2005	4444.44		
			745	755		Perforated					
537	5021.26	Shallow	585	673		Perforated	115	06/13/2005	4421.61	0.07	0.00056
767	5022.53	Deep	798	828	125	Wire wrap		06/13/2005	4421.68		
999	4937.30	Shallow	510	530		NA (probably slotted)	2,349	06/13/2005	4434.91	9.44	0.020079
275	4926.03	Deep	1,000	1,140	470	Open hole		06/13/2005	4444.34		
567	5012.4	Shallow	587.2	608		Saw slotted	346	06/13/2005	4421.28	-0.88	-0.02842
568	5031.91	Deep	639	705	31	Perforated		06/13/2005	4420.40		
514	4925.01	Shallow	456	472		Open hole	97	06/13/2005	4451.16	-4.05	-0.13501
763	4925.60	Deep	472	498		Open hole					
			528	558	30	Wire wrap		06/13/2005	4447.11		
479	4794.84	Shallow	290.00	300		Perforated	0	06/13/2005	4525.45	-12.39	-0.134
479	4794.84	Deep	392.50	398	93	Perforated (open hole)		06/13/2005	4513.08	-0.03	-0.000094
479	4794.84	Deepest	717.5	723	320	Perforated (open hole)		06/13/2005	4513.05		

a. Groups of wells that might be useful in determining if vertical gradients can be measured for the model (criteria: vertically separated open intervals, relatively near each other, single intervals each, minimal screen overlap, contemporaneous water level data, located within the model domain, not penetrating bottom of the model domain).

b. A positive value indicates an upward gradient while a negative value indicates a downward gradient.

c. Either LF2-08 and LF2-09 could be used as shallow wells paired with LF2-10.

Appendix D

External Peer Review of OU 10-08 (WAG 10) RI/FS Sitewide Groundwater Model

EXTERNAL REVIEW TEAM

Edgar Berkey, Ph.D., Chairman

R. L. Bassett, Ph.D.

Robert Smith, Ph.D.

Allan H. Wylie, Ph.D.

July 8, 2005

Dr. Thomas R. Wood
Project Manager, WAG 10 Sitewide Groundwater Model
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P.O. Box 1625
Idaho Falls, ID 83415-2107

Subject: Review of OU 10-08 (WAG 10) RI/FS Sitewide Groundwater Model

Dear Dr. Wood:

This letter provides the results of an external review of the progress you and your Project Team have made on the OU 10-08 (WAG 10) Sitewide Groundwater Model. An External Review Team (ERT) consisting of the individuals listed on the letterhead conducted the review in Idaho Falls, ID on June 7-9, 2005. Two members of this Team (Berkey and Bassett) participated in the Project Review held in 2004, while two members were new (Smith and Wylie). Collectively, this Committee has extensive knowledge of groundwater issues associated with the Idaho National Laboratory (INL) Site, as well as broader experience with groundwater modeling. Brief resumes of the Committee members are given in Attachment A to this letter.

OBJECTIVE OF THE REVIEW

The objective of the review conducted was to provide an independent evaluation of the progress that has been made implementing the WAG 10 Sitewide Groundwater Model at the INL Site.

REVIEW PROCEDURE

The basis for the review was the work conducted implementing the "Operable Unit 10-08 Sitewide Groundwater Model Work Plan" that was completed by the WAG 10 Project Team in December 2004 as document DOE/NE-ID-11188. In addition, the Team provided the ERT with a set of six questions they wanted to be addressed. Attachment B to this letter provides the agenda for the review meeting.

On June 7 and 8, the Technical Topic Leads from the WAG 10 Project Team made presentations to the ERT on their progress to date. Handout materials prepared by the Leads accompanied the presentations and were very useful to the review. There was also sufficient time for questions and answers and for discussion of points raised by the ERT.

On the morning of June 9, the ERT met to develop its major conclusions and recommendations. These were provided to the WAG 10 Team in late morning, along with a discussion of the six questions posed by the Team. Subsequently, the conclusions and recommendations were discussed with CH2M-WG management.

The ERT noted during the review that the Project Team formed to conduct the WAG 10 modeling effort demonstrated a high degree of competence and appears to have the necessary complement of technical skills to succeed with the Project. The Team is making effective use of existing data sources, applying state-of-the-art tools and techniques, and gaining many new and useful insights into the nature of the Snake River Plain Aquifer (SRPA) within the INL Study Area.

MAJOR CONCLUSIONS

1. Completion of a Sitewide Groundwater Model for the SRPA and INL Site is essential to Idaho and to DOE and will have many benefits.

The nature of the subsurface flow paths beneath the INL Site, the distribution of sources on Site, and the potential for co-mingling of groundwater contaminants from these sources make it essential to develop an accepted, integrated, regional view of the groundwater.

The ERT believes the WAG 10 Sitewide Groundwater Model Project is important to regulators, decision-makers, and stakeholders in Idaho because it promises to significantly improve the understanding of how INL Site operations impact regional groundwater quality. Successful completion of the Project is also critical to DOE's ability to secure the necessary approvals to conduct future missions on the INL Site. Moreover, it should not be forgotten that the Project has become tied to a regulatory requirement.

2. The final Work Plan for the Project is clear, comprehensive, and reasonable.

The ERT believes that the final Work Plan developed for the Project is a good document. If the Work Plan is successfully executed, there is every reason to believe the Project will attain the objective of producing a credible and defensible groundwater model for the INL Site. The contents of the Plan were negotiated with the regulators and remain the basis of an important regulatory commitment for the Idaho Completion Project.

3. The Project Team has done an excellent job translating the Work Plan into meaningful tasks and has made significant progress on these tasks in 2005 in accordance with the Plan.

The ERT strongly supports the integrated, multi-disciplinary nature of the WAG 10 Project Team. Because of this, the Team has been addressing and resolving many multidisciplinary issues in an integrated fashion. In accordance with the tasks and schedule in the Plan, the Team is making notable progress in 2005. Having subject matter experts from the Team work closely together with the modelers as an integral part of the Team has clearly enhanced the rate of progress being achieved. While many Project tasks remain technically challenging, the ERT was well pleased with the Team's progress.

The use of non-traditional, ancillary data is critical to the success of this predictive Model, which means going beyond just using simple data sources like head and concentration. The ERT noted that the Project Team understands this.

MAJOR RECOMMENDATIONS

1. The Project Team should continually articulate the logic and rationale of the technical approaches they have selected, especially the "Benefits" (not just the "Advantages") of using each approach.

The ERT noted that the Technical Leads on the Project Team often supported the particular technical approach they have selected by citing its "Advantages." While conveying an understanding of "Advantages" is certainly important, we believe it is far more important to convey an understanding of the "Benefits" provided by a particular approach, especially as those "Benefits" are linked to the goal of producing a credible, defensible Model. The Project Team needs to talk in terms of the "Benefits" of the approaches they have selected.

2. The Project would benefit from a better forum in which to engage the public, stakeholders, regulators, and the technical community.

The ERT believes that by having a better forum for engaging interested parties on a continuing basis, the Project's rate of progress would be significantly enhanced. Experience has shown that holding a series of open meetings beginning during the early stages of a project is essential to building credibility in it. The meetings should be held periodically with interested parties to convey progress being made, receive comments, resolve concerns, and develop credibility in the results.

3. The Project Team should hold more frequent interactions with stakeholders, regulators, and the technical community to discuss progress and results.

The purpose of these interactions is to contribute to confidence in Project results, improve mutual understanding of issues and concerns, and help assure that future work is properly focused and prioritized. The interactions do not need to be elaborate or time-consuming. They can take the form of open workshops, demonstrations, discussions, or presentations.

We recognize that the previous Water Integration Project did much of this, but it was at an early stage of model development efforts. It is particularly important that these interactions be increased again before modeling results start to become available, so that confidence in the Project Team's work will already have been established.

4. The Project should continue to explore alternative data sources and technical approaches, but management must ensure there is a clear connection between activities undertaken and Project goals.

The ERT supports the Project's efforts to explore the potential value of alternative data sources and technical approaches, but we caution that such efforts should not be pursued without having a clear connection to Project goals. Project management must assure that such a connection exists, or the work should not be undertaken.

5. Project management needs to be prepared to articulate the relationship between the final Model's credibility and defensibility and future funding scenarios for the Project, including defining a support level below which the modeling effort will not yield a suitable result.

The ERT understands that future-funding scenarios for the Project might potentially impact the ability to assure the credibility and defensibility of the final Sitewide Groundwater Model. Particularly because completion of the Model is linked to a regulatory requirement, Project management must be able to articulate clearly when a funding level is inadequate to assure that the Model will yield a credible and defensible result.

REVIEW QUESTIONS TO BE ADDRESSED

The WAG 10 Project Team provided six questions for the ERT to address as part of its review. The questions and the answers developed by the ERT are provided in the paragraphs that follow below.

1. Are the WAG 10 site-wide ground water modeling project's objectives clear and obtainable?

The objectives of the ground water modeling project are very clear and documented in the "Idaho National Engineering and Environmental Laboratory Operable Unit 10-08 Sitewide Groundwater Modeling Work Plan, December 2004." The Work Plan articulates the necessary tasks required to meet the Project's objectives. The resources currently allocated to implement the Work Plan appear to be adequate and are being judiciously used to achieve an acceptable level of success. The Project Team, working within existing FY 2005 budget allocations, appears to be on schedule to achieve all FY 2005 objectives. However, the ERT cautions that continued success may be jeopardized if adequate funding is not provided; including development of strategies to fund unexpected contingencies that are common to field oriented work.

The ERT believes that the interdisciplinary WAG 10 Project Team is technically competent, includes the necessary skill mix, works well together and is adequate to complete the tasks outlined in the Work Plan. The Project Team is to be commended on their efforts and progress to date. Current success is the result of the integrated efforts of the team members. Future effectiveness could be enhanced by encouraging increased collaboration with the objective of ensuring that all team members fully understand and accept the overall goals of the Project and the role of their individual contribution to achieving these goals. We expect that increased collaboration will likely result as the Project progresses.

2. Are the technical approaches for each component of the site-wide groundwater conceptual and numerical model reasonable, accurate, and defensible? Can they be improved within the limits of funding and schedule?

The technical approaches being pursued by the Sitewide Groundwater Model Project are all reasonable and supported by appropriate justification. Nevertheless, in some instances, it was not completely clear to the ERT how the results will be fully integrated into the numerical modeling activities. The Project should continue to explore alternative data sources and technical approaches while ensuring a clear connection between activities undertaken and Project goals; efforts must continue to ensure progress on highest priority tasks but should not exclude worthwhile new ideas.

Although the technical approaches being used by the Project Team are largely defensible, true defensibility will only be achieved by detailed peer review. To this end and in addition to project reviews, Project management should support and encourage the dissemination of Project results at professional society and other technical meetings and in the peer reviewed open literature. This process provides the required technical

scrutiny and review required to ensure defensibility and wide spread acceptance of results and conclusions.

Of special interest are the preferential flow path results that potentially should strongly constrain the regional flow model. How these results are being used in the two-dimensional model calibration is unclear. The ERT suggests the Project consider supporting an activity that develops a calibration based on joint inversions of the isotopic data used to define the preferential flow paths and the more traditional head data.

Another area of attention is the definition of the hydrostratigraphic units. The project's goal of incorporating detailed stratigraphic information into the three-dimensional model is ambitious and should be encouraged. However, selecting the number of hydrostratigraphic units, as well as developing unambiguous criteria to define the units requires the best efforts of the entire Team. This activity by its nature will represent a compromise between the needs of computational efficiency in the numerical modeling (less detail) and an adequate description of the geology (more detail) and thus will require concurrence of all Team members for successful implementation.

Finally, the use of temperature data and heat flow modeling to help calibrate the three-dimensional model is a high value but high-risk activity. Although the Project Team is encouraged to continue to pursue this calibration approach, it should consider alternative strategies for calibration should the temperature data set not be as robust as hoped for.

In terms of accuracy of the approach, it is still too early in the process to assess how accurate the results will be. However, the strategy of using reasonable and defensible approaches should yield the best accuracy achievable given the limitations of the data. The Project should consider the robustness of the modeling conclusions, that is the sensitivity of the conclusions to uncertainties in the data and conceptual model, as a more useful measure than accuracy, which can only be established over much longer time frames.

**3. Is there adequate connection between the conceptual and numerical models?
What fieldwork would enhance modeling work?**

The connection between the conceptual and numerical models seems adequate. The Team seems to be working well together and establishing good communication channels. Examples include the healthy debate regarding model layers, exploring preferential flow paths using isotopic tracers, and aquifer temperature studies. The

Team needs to ensure that the use of any and all model layers does not reduce model robustness. We would like to see some plan to clearly incorporate preferential flow paths and thermal studies.

As for what fieldwork might enhance modeling, the Team has already identified data gaps and fieldwork that could be performed to address the data gaps. Through modeling scenarios, the Team should provide compelling links to any fieldwork that will maximize model robustness. We suggest sampling for constituents that indicate influx of thermal water from beneath the aquifer.

4. We are ambitiously attempting to use innovative calibration targets of geochemistry, thermal modeling, and fast flow paths. Any suggestions on this approach? What other sources of information, approaches to problem, etc., have proven valuable elsewhere?

The WAG 10 sitewide groundwater modeling effort has clear objectives regarding model calibration using both conventional hydrologic data as well as the concentration distribution of the key constituents in the groundwater. The individual WAGs will provide their estimates for the quantities and rates of constituents leaving the vadose zone and entering the ground water, and the WAG 10 Team has already expended a significant effort to define the quantities and distributions of contaminants in the groundwater across the site. Preliminary modeling is already producing promising simulations of the distribution and movement of the tritium plumes.

The rate of movement of chemical constituents through the groundwater appears to be different with respect to depth and location within the individual basalt flows. Furthermore, preferential pathways are now being detected on both local as well as rather large scales. It certainly appears that to successfully calibrate and predict future transport, these factors must be incorporated into a model robust enough to simulate flow in three dimensions. The question then becomes whether the rate of movement and distribution of these constituents can be defined in three dimensions.

To that end, the use of naturally occurring chemical signatures has been proposed by the WAG 10 Team as useful tools, e.g. uranium, strontium, and other isotopic signatures, as well as the distribution of commonly measured inorganics, and potentially, rare earth elements. The Team has published some of these data already. Publications in peer-reviewed journals are encouraged by the ERT as a method for further developing the required credibility for the modeling effort.

The ERT also notes that several unresolved issues remain:

- a. For example, the depth distribution of the isotopic data is not well defined. Multi-well sampling scheduled for the future, as well as a detailed consideration of screened intervals, well depth, and geological indication of probable flow zones for historically collected samples may better define the vertical distribution of these data.
- b. The database may be further extended by integration of future sampling activities for naturally occurring indicators with sampling done by other groups on-site such as the contaminant monitoring program, the USGS, and those drilling new wells for characterization. The ERT recognizes that integrating the objectives of teams with different data needs can complicate the sample handling protocols; several ERT members have observed success at other DOE sites regarding sample collection integration. The ultimate outcome in many, if not most, cases was cost savings as well as better interpretation of the data.
- c. Capturing all major sources of these key naturally occurring signatures for preferential flow is difficult. Uncertainty exists regarding flux from deeper ground water that may be entering from the base of the aquifer. Collaboration with the newly formed team modeling heat flow and temperature distributions may provide target areas for sampling in the future to define the mass contribution from this source.

The sitewide groundwater modeling effort now underway at the INL Site is similar to that at other DOE sites, and because this Project is essential, it will likely receive increasing visibility in both the scientific community as well as the public eye. The ERT encourages the Team to interact to the extent possible with other large modeling efforts such as the ones at Hanford, Yucca Mountain, Los Alamos, etc. regarding several key aspects of the geochemical data, such as the following:

- a. Pursuing integration of data collection everywhere possible to leverage the budget.
- b. Conducting workshops and information exchanges regarding the most useful elements and isotopic entities for capturing flow rates and pathways.
- c. Examining methods to simulate reactive species along flowpaths. Some species are non-conservative and will be expected to react or sorb differently as the geology changes. For example, clays, lacustrine sediments, basalt surfaces, loess, interflow soils and fine-grained lithologies may require different sorption coefficients.

It may be far more efficient to simulate transport of such species using flow tubes or particle pathways rather than incorporating all the variables into the three-dimensional flow and transport model. Other geographically large sites have had to address these issues.

- d. Innovative methods for identifying flowpaths using geochemistry and heat flow will not be useful in the outcome, unless the data are converted into a format that the modeling group can incorporate numerically into the model. It will be essential that the geochemical, geological, and geophysical groups convert their results into data distributions that can be used for calibration and modeling, e.g., flow vectors, hydraulic conductivity distributions, etc. It seems to be the nature of the process that supporting disciplines need to take the initiative to have these data translated into forms the modelers can use for the data to be effectively implemented.
- e. Modeling results are generally improved with iterative procedures within the project framework. Similarly, iterative presentations to stakeholders will improve credibility. The ERT highly recommends that results be visible even at an early stage to the stakeholders. Presentation of interim results serves to educate the stakeholders, allows for questions and information exchange, and gives the stakeholders opportunities to understand the process and build confidence in the effort. Additional data sources and creative ideas also are often uncovered during information exchanges. Again, the Hanford System Assessment Capability modeling activity over the past 5-7 years is a valuable rubric for stakeholder interaction regarding the transport modeling program.

Finally, regarding the iterative transport simulations, future predictive modeling will be strongly dependent on the source terms for constituents leaving the vadose zone and entering the groundwater at the individual WAGs. Many of these WAGs will have obtained their Records of Decision and completed their vadose zone modeling efforts before the WAG 10 sitewide model is finished. It is not clear to the ERT how iterative corrections to the source term information will be updated if there is a need to update these data or a need for corrections to the vadose modeling over time. Preservation of data, methods and expertise would be a prudent precautionary step and perhaps should be defined and described at an early stage in this modeling effort.

- 5. The INL is entering a very cost competitive situation for clean up dollars. How do we hold costs to a minimum while not leaving DOE open to technical challenges by special interest groups with agendas against any nuclear research? How can we quantify and set bounds on uncertainty and uncertainty analysis? (i.e., what is the cost-to-benefit for performing additional work versus not performing work?)**

These are clearly critical questions to address, but neither the Project Team, CH2M-WG management, DOE, nor the ERT can answer them independently without input from regulators, stakeholders, and other interested parties. The Project Team has done a reasonably good job of interacting with regulators on the Project. However, more needs to be done on a continuing basis to engage other types of stakeholders. The ERT's impression is that building credibility with these groups regarding the Project is still at an early stage and needs to be enhanced. Therefore, much more needs to be done in this area.

Unexpected technical challenges from special interest groups come about when good communications and understandings have not been established. Over time, the dialogues will yield answers to the minimum levels of effort that are required to yield credible results. However, as discussed elsewhere in this letter, Project management needs to have a handle on when a specified funding level will not yield the desired outcome. This level is not a hard and fast number. It is typically a negotiated number with input by interested and involved parties. That is why these external interactions are so critical to the future success of the Project.

It should be remembered that completion of the Project is tied to a regulatory commitment, and so these questions must be addressed in an open forum relying on the best science available, since there will always be uncertainties.

- 6. We are particularly interested in understanding and avoiding the technical and political issues from the Groundwater/Vadose Zone Integration Project at Hanford and Yucca Mountain Sites. Within reason, how can we modify or strengthen our approach to avoid pitfalls encountered by other larger groundwater modeling projects?**

The keys to strengthening your approach and avoiding the technical and political pitfalls that other large groundwater modeling projects have faced involve: (1) maintaining open dialogue on an on-going basis with regulators, stakeholders, and interested parties, (2) addressing the issues that they raise in a non-defensive manner, (3) holding periodic progress reviews, (4) conducting periodic merit reviews using external experts, and (5) subjecting key results to more detailed external peer review.

Dr. Thomas R. Wood
July 8, 2005
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In one-way or another, each of these items has been previously addressed in this letter report. Confidence and credibility in a project is built slowly. Therefore, taking steps in this direction cannot wait until a project is ready to produce results. The steps must begin early in the project and must continue on a consistent basis until the end. The communication efforts must be carefully carried out because we have seen that one major mis-step can damage a project's credibility in a significant way. The ERT trusts that by the next review the Project Team will be able to report on all the actions they have taken in this arena.

This completes our review report.

Yours very truly,

(Original signed by Edgar Berkey)

Edgar Berkey, Ph.D.
ERT Chairman

cc: Mike Hodel, ICP
Erick Neher, ICP
Doug Jorgensen, North Wind

Attachment A – Brief Resumes of ERT Members
Attachment B – Review Meeting Agenda

ATTACHMENT A

BRIEF RESUMES OF EXTERNAL REVIEW TEAM MEMBERS

Edgar Berkey Dr. Berkey is Vice President, Research and Development, and Chief Quality Officer for Concurrent Technologies Corporation. He is a senior consultant to the Department of Energy (DOE), Environmental Protection Agency (EPA), and industry with over 35 years of experience. He holds a B.S. in Chemical Engineering from Stanford University and a Ph.D. in Nuclear Science and Engineering from Cornell University. He was a member of DOE's Environmental Management Advisory Board (EMAB) for six years, EPA's Science Advisory Board for four years, and chairman of the Groundwater/Vadose Zone Expert Panel at Hanford for three years. He has chaired the Energy and Environmental Technology Directorate Review Committee for the Idaho National Engineering and Environmental Laboratory (INEEL) and is also a member of the Laboratory Advisory Committee, as well as the Environmental Technology Directorate Review Committee of the Pacific Northwest National Laboratory (PNNL). Dr. Berkey is also a member and former chairman of the Environmental Advisory Committee for DOE's Savannah River Site (SRS). He has been an adjunct Associate Professor of Environmental Engineering at the University of Pittsburgh and Co-Director of the EPA-funded Groundwater Remediation Technologies Analysis Center.

R.L. Bassett Dr. Bassett is president of Geochemical Technologies Corp. He was a Professor in the Department of Hydrology and Water Resources at the University of Arizona for 14 years, where he continues as an adjunct Professor and directs the isotope laboratory. He holds a B.S. in Geology from Baylor University, a M.S. in Geochemistry from Texas Tech University, and a Ph.D. in Environmental Geochemistry from Stanford University. He has been principal investigator for numerous field and laboratory research projects such as DOE Siting Studies in Arizona. He has published extensively in peer-reviewed journals on issues related to radioactive waste geochemistry, ground water geochemistry, siting, isotopic geochemistry, contaminant migration and transport. He was a Darcy Distinguished Lecturer and an Associate Editor for the journals of Water Resources Research, Ground Water, and Applied Geochemistry. He has served on numerous review panels and boards, such as the University of Waterloo Centre for Groundwater Research Advisory Committee; National Academy of Sciences Committee on Low Level Radioactive Waste; Argonne National Laboratory Radioactive Waste Review Panel; Board of Directors of the National Ground Water Association, Association of Ground Water Scientists and Engineers; and the Hanford Ground Water/Vadose Zone Expert Panel.

Robert W. Smith Dr. Smith holds the title of Distinguished Professor of Subsurface Science and is a member of the Biological and Agricultural Engineering Department at the University of Idaho. He received his M.S. and Ph.D. degrees from the New Mexico Institute of Mining and Technology in Geochemistry and Geosciences, respectively. Dr. Smith is a biogeochemist with 23 years experience contributing to and leading interdisciplinary research and engineering projects focused on the fate, mobility, and remediation of contaminants in subsurface environments. In particular, Dr. Smith has 16 years research experience in the Eastern Snake River Plain Aquifer assessing regional hydrochemistry and developing innovative microbially-based remediation technologies. He is a principal investigator in the Department of Energy's Environmental Management Science Program and a past principal investigator in the Natural and Accelerated Bioremediation Research Program. He has published 34 reviewed papers, organized and served as editor for the "Scientific Basis for Nuclear Waste Management XXIII" symposium, and has given over 70 presentations at scientific meetings. Currently Dr. Smith is exploring the applicability of centrifuge techniques to investigate biogeochemical processes under variably saturated vadose zone conditions, novel microbial approaches for *in situ* stabilization of metal and radionuclide contaminants, and the geologic sequestration of carbon dioxide in deep, mafic-rock-hosted aquifers.

Allan H. Wylie Dr. Allan Wylie presently works as a hydrologist for the Idaho Water Department of Water Resources. He holds a bachelor's degree in earth science from Chadron State College in Chadron, Nebraska, a master's degree in geology from the University of Montana, and a Ph.D. in geology from the University of Idaho. Within the Idaho Department of Water Resources, Dr. Wylie's responsibilities involve conducting analysis in support of conjunctive ground water and surface water administration. Prior to coming to work for the Department, Dr. Wylie worked for the University of Idaho, where he helped develop a ground water flow model of the Eastern Snake River Plain Aquifer.

ATTACHMENT B
REVIEW MEETING AGENDA

<u>June 7, 2005</u>		<u>TSB Conference Room C</u>
8:00 AM	Welcome and Introductions Meeting Objectives and Agenda	Erick Neher
8:30 AM	OU 10-08 Overview Purpose, background, drivers, schedule, integrated data collection and modeling approach	Tom Wood
9:00 AM	Flow and Transport Overview Contaminant Sources	Swen Magnuson
9:30 AM	Conceptual Model Overview	Brennon Orr
10:30 AM	Break	
10:45 AM	Aquifer and Tributary Basins Stratigraphy	Catie Helm-Clark
12:00 PM	Lunch	
1:00 PM	Aquifer Temperature Studies	Mitch Plummer
1:45 PM	Aquifer Preferential Flow Paths	Travis McLing
2:30 PM	Contaminant Plume Interaction Interpretation	Mike Roddy
3:00 PM	Break	
3:15 PM	Hydrostratigraphic Units and Conceptual Model Integration	Robert Podgorney
4:00 PM	FY-05 Coreholes: Multi-level Completion	Erik Whitmore
4:30 PM	Recap of Conceptual Model; Questions and next day logistics	Syl Losenski

REVIEW MEETING AGENDA (Continued)

	<u>June 8, 2005</u>	<u>University Place</u>
8:00 AM	Code Selection Process 2-D Flow Model Status and Calibration	Hai Huang Mike Rohe
9:00 AM	Thermal Modeling	Mitch Plummer
9:45 AM	3-D Flow Model Development Approach	Swen Magnuson
10:00 AM	Break	
10:15 AM	Transport Modeling Contaminant Migration	Mike Rohe
10:45 AM	Response Surface Modeling	Art Rood
11:15 AM	Sensitivity Uncertainty	Hai Huang
11:45 AM	Summary Numerical Model	All
1:15 PM	Working Session	Review Team
3:00 PM	Break	
3:15 PM	Call Back Question and Answer	As Requested

	<u>June 9, 2005</u>	<u>University Place</u>
8:00 AM	Working Session	Review Team
11:00 AM	Close Out Session	All
12:00 PM	Finish	